PUBLIC WORKS

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VOL. 72. NO. 1

TIMEWASTERS

An Unlucky Number:

Using four "3"s, no more, no less, combine to make 13. You can subtract, divide, add or multiply.

A Snow Ball-up:

Three brothers, Andy, Bill and Carl, agreed to share equally at night all the money they made one Saturday shoveling snow. To make the dividing more interesting, Andy first, out of his own earnings, handed each of the others a sum equal to what he had earned. Then Bill handed his brothers enough to double the amount each then held. Finally Carl handed Andy and Bill enough to double what they then held; and they found that each then had 64 cents. How much did each earn?

Literal Arithmetic:

We give the Timewaster fans this month a sample of literal division to solve. Literal arithmetic may be old stuff to some but will probably be new to others. If the proper digit be substituted for each letter in this, a correct example in division will be obtained. As a first step, it is evident that K is 0 and P is 1. Finally, arrange the letters in the order of the digits that they represent.

```
UCW | PLPIBRR | IBKP
      PBBI
       OKB
       OKP
         URR
         UCW
          BU
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A. PRESCOTT FOLWELL, Editor

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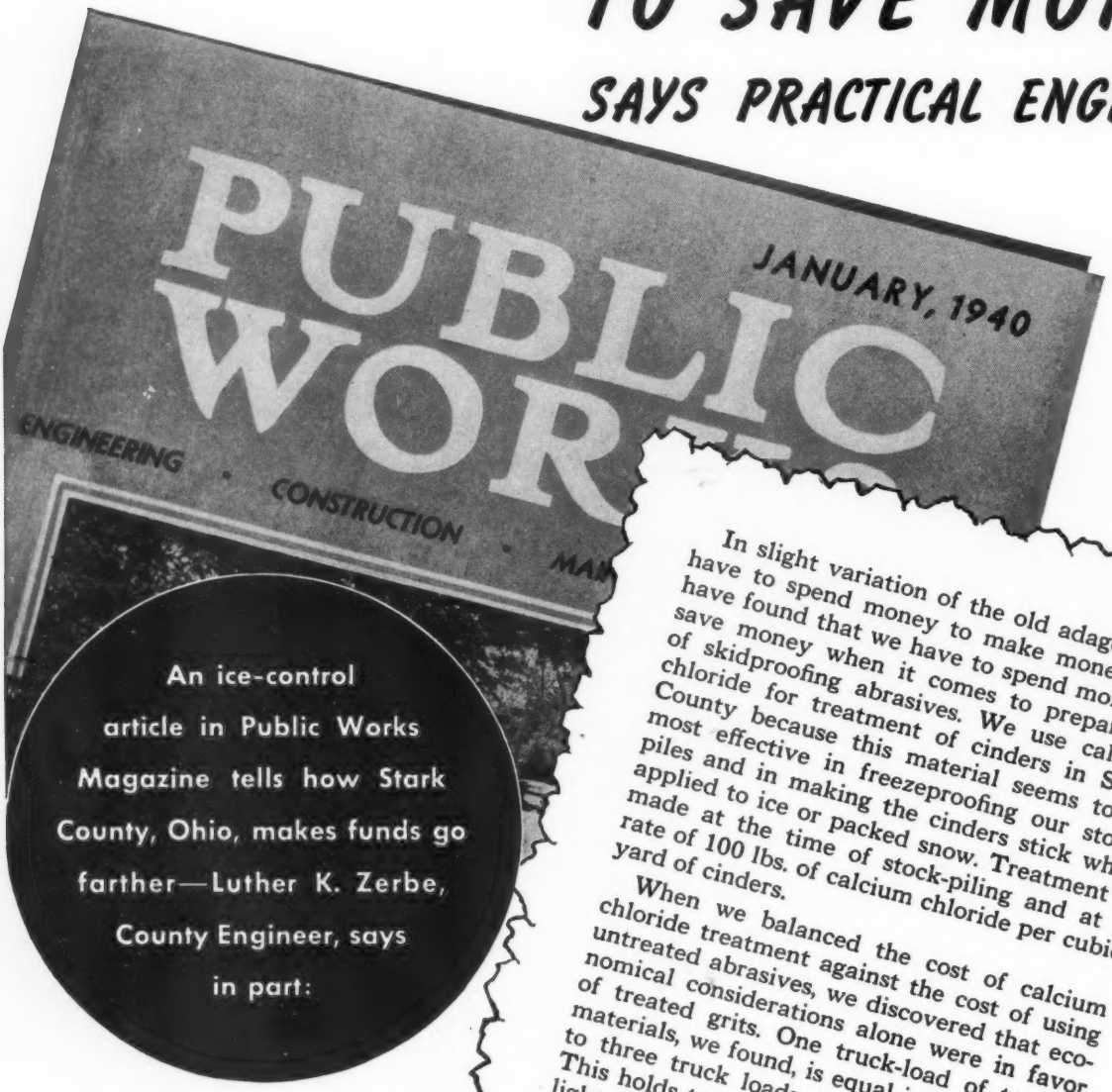
"WE USE TREATED GRITS TO SAVE MONEY" SAYS PRACTICAL ENGINEER



An ice-control article in Public Works Magazine tells how Stark County, Ohio, makes funds go farther—Luther K. Zerbe, County Engineer, says in part:

In slight variation of the old adage, "You have to spend money to make money," we have found that we have to spend money to save money when it comes to preparation of skidproofing abrasives. We use calcium chloride for treatment of cinders in Stark County because this material seems to be most effective in freezeproofing our stock-piles and in making the cinders stick when applied to ice or packed snow. Treatment is made at the time of stock-piling and at a rate of 100 lbs. of calcium chloride per cubic yard of cinders.

When we balanced the cost of calcium chloride treatment against the cost of using untreated abrasives, we discovered that economical considerations alone were in favor of treated grits. One truck-load of treated materials, we found, is equal in effectiveness to three truck loads of untreated material. This holds true because we can make much lighter application of the treated abrasives, which dig into the icy surface and resist the displacing action of traffic and wind.

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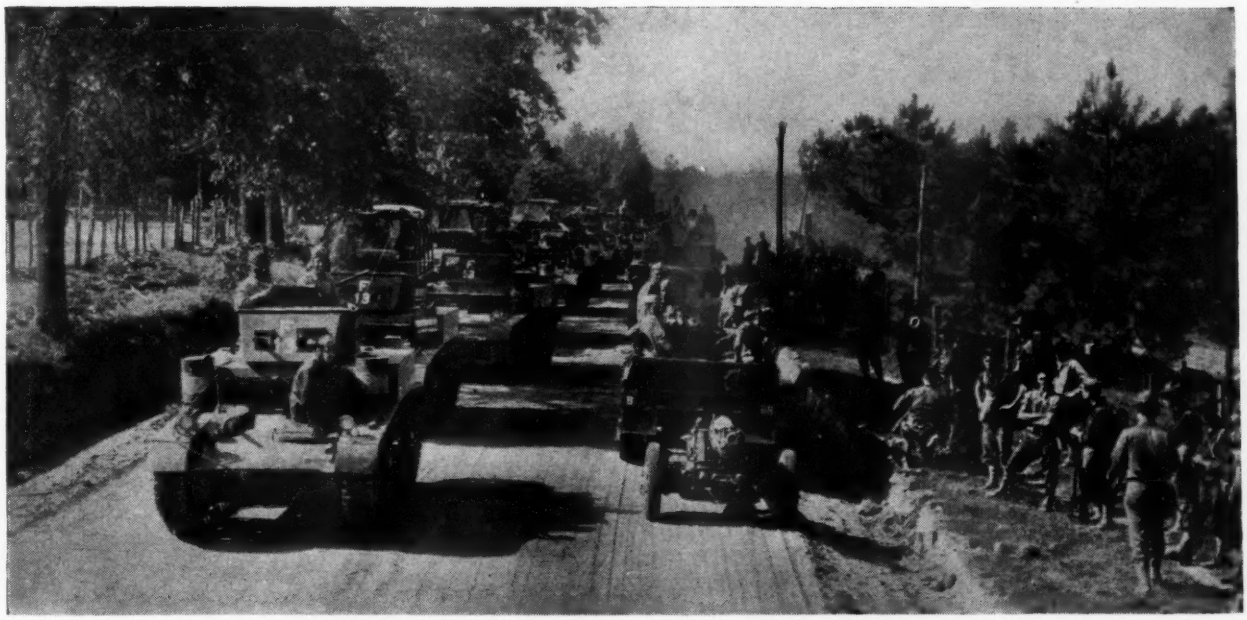


Mechanized cavalry in maneuvers at Camp Beauregard, La.

How National Defense Will Affect Highway Construction

By R. E. ROYALL

Senior Highway Engineer, Public Roads Administration

THE nation-wide activity in preparing the country for national defense has already brought an increased use of highways. This use will increase greatly as the program develops and there will be an intensive use should actual defense become necessary.

With 1,300,000 miles of surfaced road, nearly 5 million trucks and 26 million passenger vehicles, we have highway transportation facilities not approached in any other country. We are prepared to make an immediate use of these facilities in all of the many operations and undertakings of our War and Navy Departments in preparing the country for defense.

It is true that our highway system is far from complete—that years of work will be required to bring it to a satisfactory condition—but this does not lessen the value of what we now have. A completed system would greatly speed up and facilitate all highway movement but there is no possibility of completing the system as an emergency measure in a short period of time.

However, the close cooperation that has existed between the Public Roads Administration and the War Department for several years has developed certain definite highway needs, one class of which should be provided immediately as a part of actual military and naval preparation and the other is of such importance as to justify giving it first place in our regular highway program.

Work to Be Done

These classes of work are as follows:

1. The construction of roads giving access to new and enlarged army camps, depots and training centers and to industrial plants supplying arms, muni-

This Virginia highway, like most of our main highways, has adequate strength to carry all military loads. Shoulders needed to provide two lanes for civilian traffic.

tions and other defense materials and supplies. Many of these camps and plants must also have service roads within their areas.

2. The strengthening of weak links in the 75,000-mile system of strategic highways selected by the War Department as important for national defense.

These are the jobs that should receive attention now and which may be accomplished within a reasonable length of time. The classes of improvements recommended by the Public Roads Administration in the report TOLL ROADS AND FREE ROADS of April 1939 are of great importance for a smooth and continuous flow of traffic on main highways.

The outstanding recommendation of this report was the improvement of an interregional system of highways approximately 30,000 miles in extent with express highways carrying the traffic through large cities. The plan contemplates the modernization of existing highways to form a large part of the system, and building 4-lane divided highways wherever the volume of traffic warrants. It is realized that accomplishment of this plan requires large resources in money, men, and materials. Any attempt to carry it through in a short period of time would produce serious conflicts with the most urgent defense activities. However, this work is regarded of first importance in the long-term highway program for both defense and normal peace-time needs.

Developments of the past few months have placed the construction of access roads and streets for Army and Navy reservations and for new and expanding defense industries at the head of the list of highway work for defense. In the building or expansion of any camp or plant, roads are a first need for hauling materials, and the daily movement of construction workers. Later the roads will be needed for all the various kinds of traffic to and from the camps or plants. The importance of this work became evident with the passage of the national guard and selective service acts and the appropriations for equipping an army with all the instruments of modern warfare.

The movement of men to training camps is already under way and schedules are being drawn for the completion of housing facilities and the movement of additional thousands. Camps that housed only skeleton organizations are being prepared for the training of 40 to 60 thousand men and entirely new camps are being laid out.

There is intense activity in the production of arms, munitions and equipment for this new army. New plants are being established. Those for the manufacture of explosives are being located on large tracts of land where entirely new roads must be built to serve the plant. Many of the existing plants are being greatly expanded with the result that building operations and the expanded operation of the plant will generate highway traffic much in excess of the capacity of existing roads.

The need for access roads to the many military establishments and plants producing defense materials is so urgent that steps are being taken toward their immediate improvement with such highway funds as may be assigned for the purpose by any agency. Conferences are being held at each of the camps and plants lacking in access roads. Participants in the conferences are one or more officers of the Army or Navy, a representative of the State highway department and of the Work Projects Administration State office, county or city authorities that may be involved in the planning, and the district engineer of the Public Roads Administration.

Funds Available

In addition to planning specific locations of access roads, the conferees are considering the approximate cost of these improvements and the money available from different agencies for construction. Some of the available sources of money are the following:

1. Regular Federal-aid funds apportioned to the States and not yet obligated for construction, or to be apportioned before the end of the year totaling about 198-million dollars for the Federal-aid system, about 38-million for secondary or feeder roads, and about 68-million for grade crossing eliminations.

2. Funds authorized to be spent under the normal plan of operation of the Work Projects Administration, with the provision that not to exceed 25-million dollars of this total may be expended to pay for supervision, equipment, and materials in excess of the amounts normally expended for these purposes. on roads certified by the appropriate defense agency as strategically important.

3. Such amounts of State and local money as can be contributed.

4. Funds appropriated to the War and Navy Departments and allotted for expenditure on contracts let by the constructing quartermasters or public-works officers of the various posts. These funds are generally available at present only for certain roads to be improved or constructed within the reservations.

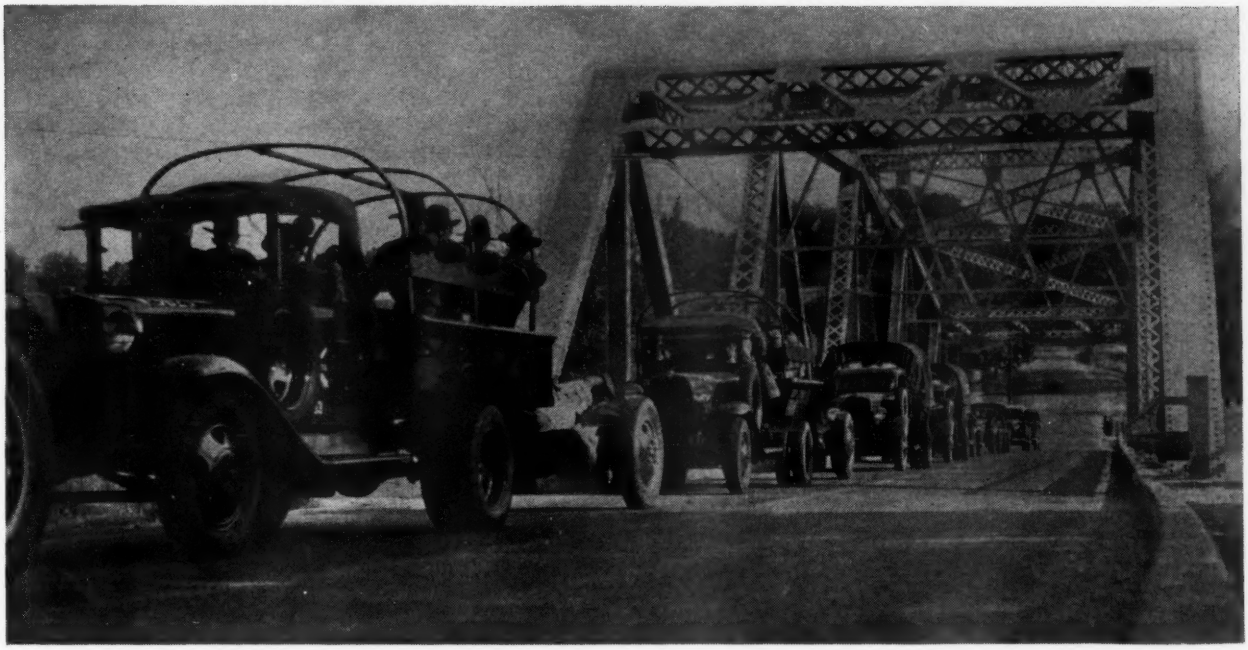
The formal conferences have the benefit of considerable planning done in many preliminary conferences throughout most of 1940. These preliminary conferences resulted in the preparation of detailed maps of many military posts, showing the access roads and streets the conferees assumed would be required to condition the reservations for training purposes.

Some of these roads already are under construction as a result of the prompt action of the highway departments in several States.

Most of the work of these preliminary conferences was done, however, before the national defense program had gained much headway. In the weeks following the early conferences, the defense program began taking shape.

Congress determined the number of men to be given military training, and the schedule was arranged for moving these men into the military and naval reservations. The War and Navy Departments located new cantonments, bases, training centers, and tactical areas. The National Defense Commission and its advisory council was created, and has determined the

(Continued on page 32)

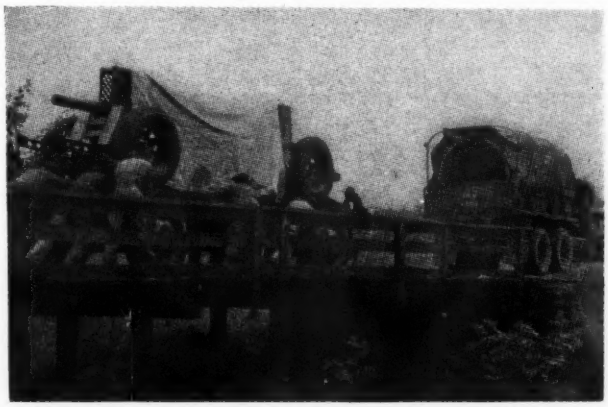


Highway bridges designed under the H-15 standard are fully capable of carrying all army equipment.

Strengthening and Widening Highway Bridges

By E. E. BRANDOW
Bridge Engineer, Pennsylvania Department of Highways

How the Pennsylvania State Highway Department strengthened and widened or replaced its inadequate bridges.



Pushing trucks over a weak bridge during last spring's maneuvers in East Texas.

IN THE FALL of 1921, the collapse of a borough-owned bridge, with an attendant loss of 15 lives, caused the Department to investigate the physical condition of each and every bridge located on roads included in the State Highway System and on roads toward the improvement of which the State had contributed, and to make a separate record for each individual bridge.

This record showed the actual physical condition of the several component parts of the structure as found at the time of inspection. Dangerous or bad conditions were described in detail. The record further included such additional information as ownership, date of erection, type of structure, kind of materials used in the construction, general dimensions, composition of individual members, alignment of approaches, character of stream bed, nature of stream and other data pertinent to the safety of the structure and of the user. Wherever possible, sufficient data were gathered and recorded to enable us to compute the capacity of the structure.

Reinspection of the bridges was made thereafter at intervals and the records revised and corrected to agree with subsequent changes in conditions or new and additional data. Present policy of the Department requires that every bridge be inspected once each year and that bridges posted for restricted loading and timber bridge floors be inspected at three-month intervals.

The first wholesale bridge inspection disclosed the following facts: (1) most structures had a roadway too narrow for the safe operation of high speed traffic; (2) most of the steel and iron structures were in immediate need of repairs, particularly to floors and stringers; (3) floors and stringers were the weakest part of bridges; (4) a number of bridges had deteriorated dangerously close to failure and required immediate replacement; (5) in covered timber bridges, the timber in the trusses was, in nearly all cases, in fair condition but joints and floor system were weak and the timber was badly rotted where it was in contact with masonry; (6) the concrete in many concrete structures was rapidly disintegrating; (7) all-stone arches were, with few exceptions, in good physical condition;

Allegheny River bridge before widening.

(8) flooring concrete on buckle plates and corrugated metal arches was very porous and of such poor quality that it dropped out whenever the supporting metal rusted away; (9) substructures were generally in good condition; (10) cases of stream scour and undermining of substructures were very few in number; (11) in most cases the alignment of bridge approaches was very poor.

When the State established the State Highway System and created the Department of Highways, it vested in the Department only those responsibilities with respect to the roads taken over as had theretofore been vested in the townships. Whenever the construction of a bridge involved an expenditure greater than the township could bear, the county either built the bridge for the township or assumed complete responsibility for the construction and maintenance of the bridge. Consequently, only the smaller bridges were the responsibility of the townships and became the responsibility of the State on the taking over of the roads. Bridges which were the responsibility of the counties remained their responsibility.

During the decade that followed, the State replaced most of its bridges, along with the improvement of the roadway. The Department succeeded in most cases in inducing the counties to replace their weak and inadequate bridges whenever a section of highway about to be improved included such a county structure. In nearly all such cases the Department furnished the engineering, plans, specifications and supervision without cost to the county, as permitted by law.

In 1929 the General Assembly relieved the counties of their responsibility for the county bridges located on state highways by transferring the responsibility to the State Department of Highways.

Many of the bridges on the improved sections of state highways had by this time been replaced by new structures with adequate width roadways for the traffic then traversing them. There still remained a considerable mileage of unimproved roads on the State System which included many bridges requiring repairs, strengthening or replacement.

One of our bridge men who possessed a natural instinct for locating defects in existing structures and was particularly adept in devising methods for repairing and strengthening, was selected to direct the Central Office end of the work of strengthening and repairing structures and to act as consultant to the several district maintenance engineers in such work.

Most of the bridges on roads included in the State Highway System prior to 1932 are now capable of carrying the legal maximum load of 13 tons on four wheels without distress. The accomplishment of this work is in large measure due to the use of electric arc welding, without which the cost in time, money and inconvenience would have been prohibitive.

Many of the bridges taken over by the Department under the Act of 1929 were light pony truss spans of less than 80 feet, with narrow roadways. The cost of strengthening and widening these structures would have been out of all proportion to the results. Such superstructures were replaced with I-beam spans on the existing substructures at a cost only slightly greater than the estimated cost of strengthening and widening the original structure. First designed as cheap temporary structures, these I-beam bridges were later developed into a higher and more permanent type of structure.

The original State system of highways was established in 1911 by the adoption of approximately 8,835 miles of township roads. The General Assembly at every session added a few hundred miles to the system until 1931 when it added approximately 20,000 miles but excluded all bridges exceeding a span of 10 feet. In 1935 it placed on the Department responsibility for *all* bridges on the 20,000 miles of road added to the system in 1931. The State Highway System today consists of about 40,522 miles of roads. Whenever a section of highway was added to the State system, all bridges on the section were inspected and a record of their condition together with other pertinent data compiled and placed in our files.

The roads added to the State system in 1931 were secondary highways, and the bridges located on these roads had generally been accorded secondary attention by their previous owners. The Department was, therefore, on the first of January, 1936, confronted with a highly aggravated problem of bridge repair and strengthening and with a very much smaller amount of money to accomplish the task. This problem was still further aggravated by the widespread floods of March, 1936, which swept away about 274 bridges (none of which were modern) and damaged a large number of others.

This summer the U. S. War Department informed us of the selection of certain highways as defense roads. Our check showed that only a very few of the bridges on the designated highways failed to meet the War Department's requirements for lateral and overhead clearances and carrying capacity. Those which failed to meet the requirements had been slated for replacement. Additional defense roads, when selected, may include some of our secondary highways and the percentage of bridges failing to meet requirements will probably be considerably greater.

Methods of Strengthening

In strengthening and widening bridges, various methods are employed, each case presenting its own

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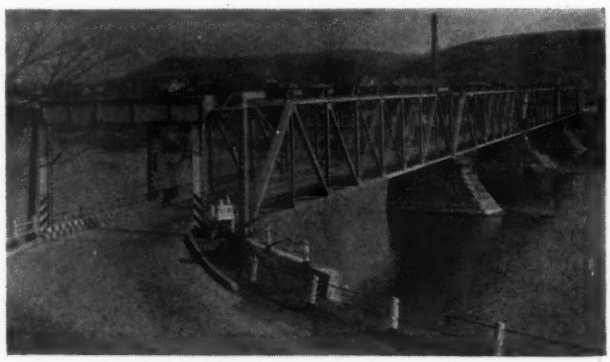
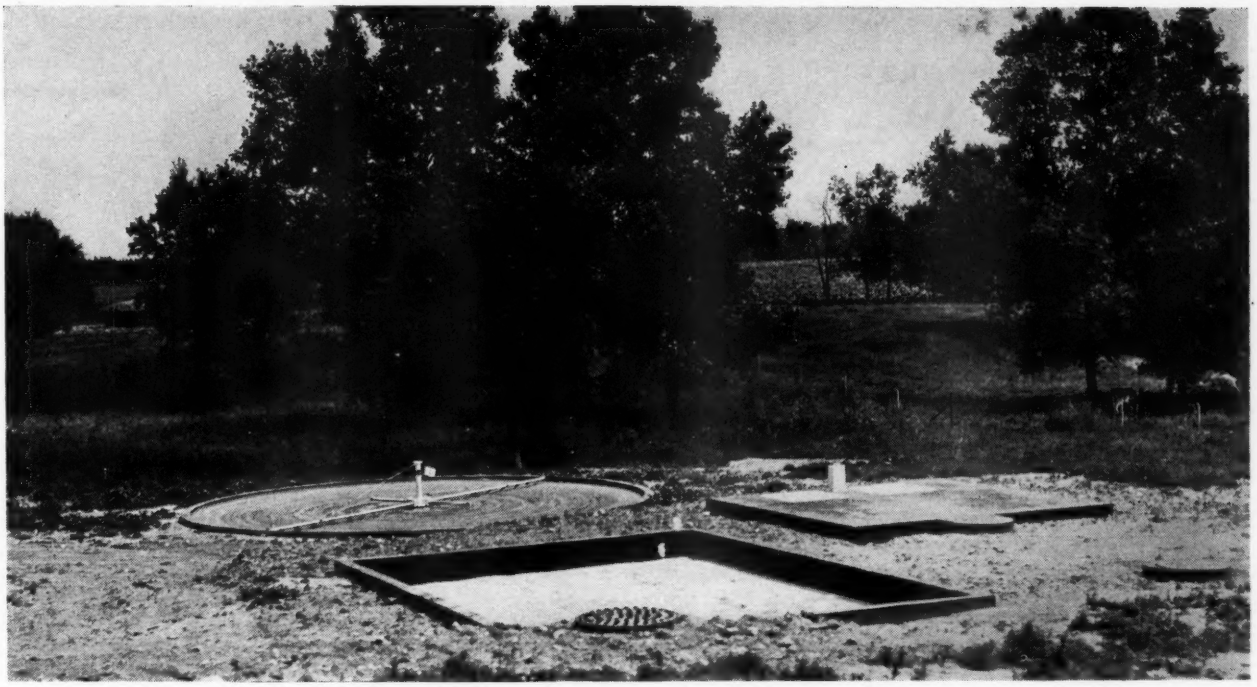


Allegheny River bridge after widening and strengthening.



Small treatment plant showing rotary distributor on sand filter.

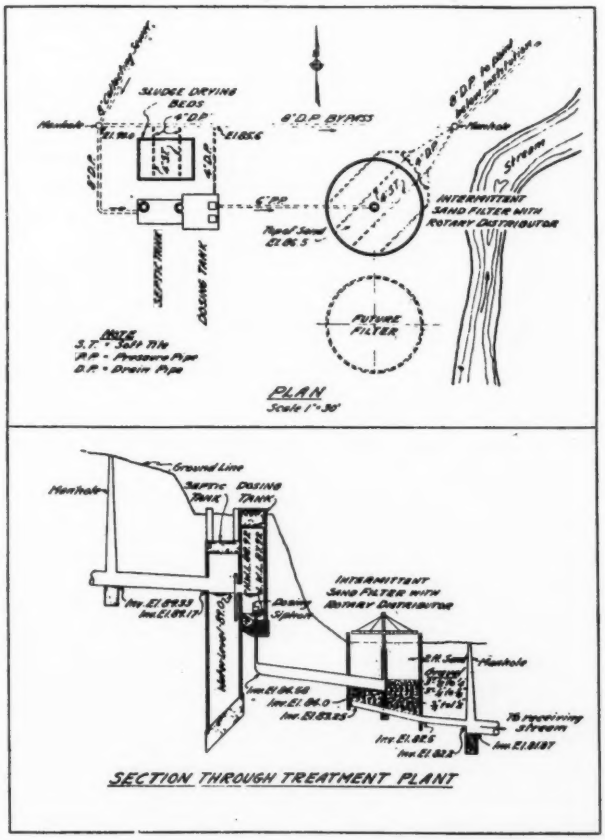
Rotary Distributors of Sewage for Sand Filters

As Described by
H. A. STEPLETON

SAND filters used in sewage treatment plants ordinarily are dosed through troughs or pipe laid upon the surface, but sewage run upon the bed in this way probably never is distributed uniformly over it; even if the liquid portion covers the entire area uniformly, there is a greater percentage of solids near the trough or pipe than at other parts of the filter. This of course results in non-uniform and uneconomical use of the sand bed.

In order to secure more uniform distribution, sewage at two small Ohio plants is being distributed by means of the type of rotary distributor used for trickling filters. The plants referred to are at the Allen County Infirmary and the Allen County Children's Home, located near Lima, Ohio, and have been in operation since July, 1940. Each has a varying population never exceeding 150.

In each plant the sewage passes through a plain sedimentation tank giving a detention period of 12 hours, from which it discharges into a dosing tank containing one 4" siphon which discharges 1,080 gallons at a time. It was considered advisable to provide as long a rest period as possible for the sand filters and the dosing tank was therefore constructed of sufficient capacity to give an average of four to six dosings in 24 hours. The dosing requirement recommended by the State Department of Health for sand filters is 100,000 gallons per acre per day. By securing the uniform distribution provided by the rotary distributor it was thought practicable to increase this to 200,000 gallons and thereby reduce the filter area by 50%. In



each plant the filter is 36 ft. in diameter and contains 24″ of sand having an effective size of 0.3 to 0.45 mm and a uniformity coefficient not greater than 3.0; supported by 8″ to 12″ of graded gravel, the effluent being carried off by 4″ underdrains. The filter is bypassed during cold weather.

At one plant the operator, using an ordinary garden rake, breaks up the thin crust on the bed once a week; at the other plant the collected matter is removed by a curved scoop. It is too early yet to learn which is the better method.

Analyses of the sewage and effluent are not made regularly, but were made at each plant once in August and once in September by E. E. Smith, Superintendent of the Lima sewage treatment works. He reports that at the Infirmary plant suspended solids were reduced from 100 as applied to the filter to 10 in the effluent on one date and on the other date from 107 to 30. At this plant the dissolved oxygen is increased from 0 as applied to 8.9 in one case and 1.3 in the other. The BOD was reduced from 135 to 6 on one date and from 190 to 4 on the other. Pounds of BOD removed per acre per day were calculated to be 394 on one occasion and 408 on the other, the former with a flow of 8,100 gallons and on the latter date of 5,940.

At the Children's Home with somewhat lower flows, the suspended solids were reduced from 56 to 4 on one date and from 44 to 2 on the other. The dissolved oxygen was increased from 0 to 5.8 and to 7.5 and the BOD reduced from 60 to 1 and from 76 to 2. Owing to the weaker sewage at the Children's Home, the BOD removed per acre was considerably less, although the percentage removed was practically the same, ranging between 95 and 98 in all four tests.

The cost of each filter and rotary distributor was $1,740, with $360 additional for the dosing tank. It is estimated that the cost of a sand filter of twice the size with the ordinary trough distribution would have been $3,000.

Incidentally, in connection with installing the treatment plants, the sewers between the plants and the buildings were relaid. In each case the old sewer passed within a few feet of the well supply, and in order to insure against contamination of this, the sewer was replaced with one of cast iron pipe.

The above information is from a paper before the Fourteenth Annual Conference on Sewage Treatment at Columbus, Ohio, by H. A. Stepleton of H. P. Jones & Co., consulting engineers for the plants.

Dust Storms Clog Trickling Filters

Studies made at the Huron, South Dakota, sewage treatment plant during the past year revealed that the efficiency of the trickling filters was far below normal. Alfred Ross, Superintendent of the Plant, found that after removing part of the filter stone the filters were clogged for two or three feet of their depth with mud and dirt. It is presumed that this accumulation of inert material on the stone was the result of the high winds and drought responsible for the dust storms of a few years ago. There were times when such storms piled considerable wind borne material on the surface of the trickling filters. By the use of high pressure fire streams, it was possible to flush this foreign matter from the filters so that their efficiency gradually increased to somewhere near normal. In spite of the excessive amount of mud and dirt collected by the filters, there has been no unusually large amount of ponding on those beds.

Laying Cast Iron Main Through a Swamp

Early in 1940 a contract was let for replacing 63,000 ft. of 14″ water main to bring from the Mississippi River water for supplying Thibodaux, La., a town of about 6,000 population. This pipe was Super de Lavaud lined with cement centrifugally applied not less than 1/16″ thick with a seal coat, and the outside given a prime coat and two separate coats of bituminous enamel with a total thickness of not less than 3/32″ thick; the latter because 39,000 ft. of it was to be laid underground in a highly acidic muck soil. The manufacturers voluntarily wrapped the pipe with felt to protect the enamel coat, which they considered was justified by the safety with which the pipe could be handled without destruction of the coating during transportation or laying. The enamel coating was left off the bells and also 6″ of the spigot end of the pipe, which were to be jointed with melted lead, and these surfaces were covered with bituminous enamel after the lead joints had been poured and calked.

Since this pipe was laid through a swamp and 24,000 ft. of it was elevated above the surface on pile bents, the contractor had to employ unusual methods in conveying and handling it. The pipes were unloaded from the cars to trailer trucks equipped with rubber-covered cradles for carrying the pipe and were distributed where possible with tractors having 16″ extension treads further extended with 2″ x 4″ oak strips giving a total tread width of 24″. Where tractors were not possible, barges were used.

The pile bents upon which the pipe were supported were spaced 18 ft. apart, piles 20 ft. long being driven in pairs which supported a cap on which the pipe rested. The pile driver, using a 1000-lb. hammer, was supported on skids. At one point the pile driver sank almost out of sight into the swamp. When possible, a mud sled equipped with a hand winch was used for putting the pipe on the bents but in some cases a barge was used instead. Due to the difficulty of getting an air compressor into the swamp, the joints here were hand-calked and the equipment carried on either the mud sled or a boat.

Where the pipe was placed underground, a trench was cut with a Link-Belt Speeder Crane using a ½-yd. drag bucket, cutting a trench with sloped banks. The pipe was lowered into the trench with a side-boom Caterpillar tractor using an 8″ belt sling. The lead furnace and the pot for heating the bituminous enamel were carried on a sled, as was also the air-compressor used for calking with an air-hammer. After calking, the joints were thoroughly washed and dried and joints and bells primed and coated with three coats of enamel. The pipe was supplied by the U. S. Pipe & Foundry Co. and installed by Williams Bros. of Tulsa, Okla. The engineers were the J. B. McCrary Co. of Atlanta.

How Lexington Collects Leaves

City Engineer M. J. McGruder of Lexington, Ky., has adopted an idea of collecting leaves from the city's streets which is apparently a novel one. He uses a hay baler for handling the leaves after they have been raked into gutters from yards and sidewalks. This not only is more successful and cheaper than loading them into trucks by hand, but also solves the problem and expense of disposing of them, since a local nurseryman, using his own trucks, picks up and removes the bundles of leaves, which he uses as mulch for fertilizer.

To truck all this material to camp daily, in muddy as well as dry weather, requires wide, hard-surface roads on good foundations.

Access Military Roads

By GEO. E. MARTIN
Consulting Engineer, General Tarvia Dept., The Barrett Co.

BEFORE discussing the various methods for improving access roads, it might be well to determine just what sort of roads the term covers. Thomas H. MacDonald, U. S. Commissioner of Public Roads, in a recent speech before the American Association of State Highway Officials defined access military roads as follows:

"Access roads consist of feeder roads and streets providing connections from the strategic network and other main roads to military and naval posts and reservations and air bases, those serving industrial areas and plants and those serving civil airports, railroad terminals and depots.

"There are approximately 2,000 miles, as of the present date, of roads serving military and naval reservations but outside of these reservations. All roads in this category are of immediate importance, with first priority attached to those serving the training camps which will be first occupied."

Evidently then, the problem is the improvement of comparatively short stretches of highway up to the point where they will be adequate to meet the needs of roads used for military traffic. These needs are about the same as for civil traffic. The H-15 specification loadings which are used for rural highway bridges are adequate to carry all military loadings which have been proposed up to the present time. The wheel loading of 9,000 pounds carried on pneumatic tires proposed for military traffic is about that used for the design of civil highways.

A finished access road paved with bituminous material.

Width is an important factor in all military highways. Much of the delay and congestion of traffic in the late war was due to inadequate width of the roads. One broken-down piece of equipment would tie up traffic for miles. From the news reports, something of the same sort happened in France and Belgium during the present war. Twenty feet would seem to be the minimum width for the pavement. Wide shoulders are of great value on military highways. A shoulder width of ten feet would make possible the repair or storage of disabled vehicles without interference with the flow of traffic. This may be more width than can be provided in some instances. One alternate would be the construction of the ten-foot shoulder on only one side of the road. If shoulders cannot be built, turnouts at least should be provided. It has been suggested that ten-foot wide turnouts be constructed one-half mile long at intervals of four miles. They would be staggered so that a turnout would occur on one side of the road or the other every two miles.

The location of the access road is an important matter. It would seem foolish to depend upon one access road connecting a camp or airport with the main highway system. Yet this is often done. One airport was seen recently where the traffic serving the commerial air lines and an army air base was all carried on one access road. Two or more access roads should be provided for each facility so that a closure of one road will not completely isolate the camp, industry or other facility served.

Along these same lines, plans should be made to handle the civilian traffic in addition to the military

traffic. This is probably less important on access roads than on the other types of military highways but it still may be a factor of grave importance. Plenty of access roads would seem to be the answer.

Access roads will require some maintenance. Adequate provision should be made for this in advance. The man in charge of the facility may not be trained in highway maintenance operations. Therefore, it would seem better to make the local or State highway officials responsible for the maintenance of the access roads. At the same time arrangements for the financing of the maintenance operations should be made.

Having located the access roads and determined upon their width, the next problem will be to decide upon how they are to be improved.

Access roads, before improvement, may vary from a strip of virgin right-of-way to pavements which are almost adequate for service as they stand. Standard designs and methods used in the particular locality should be satisfactory for access military roads. There is a distinct advantage in using local methods since the contractors and highway officials are familiar with them and satisfactory results can be obtained at a reasonable cost.

On an entirely new location, a high type, rather expensive pavement may be the best solution in some cases. Time and weather conditions during construction are often factors of great importance. Gravel and macadam bases, for example, can be constructed if necessary practically regardless of weather conditions. They are also easily repaired and strengthened if local failures do occur when the road is in service. Some of the access roads to camps in the late war were kept passable for traffic during the winter of 1917-18 by dumping gravel, stone, broken brick or other available materials in the holes as they came. Not the best road, to be sure, but the camp could always be reached from the main highways.

Bituminous surfaces of various sorts lend themselves readily to the improvement of existing access roads. Both road mix and plant mix materials may be used. The choice will depend upon availability and cost. While these materials work best in warm, dry weather, they can be used even in cold weather. For adverse weather conditions the plant mix is most satisfactory, since the mix is made under controlled conditions at the central mixing plant.

One example of a road mix used to strengthen existing access roads is in connection with the new ordnance plant near Ravenna, Ohio. The plant buildings are widely scattered over a large area. This area contained a network of local roads, varying from poor gravel to bituminous surface treatments in fairly good shape. A road mix of the re-tread type was used to strengthen the existing roads. The depth of the re-tread top varied from two to four inches depending upon the condition of the existing road. Slag was used as the aggregate with a bituminous binder.

Another example is an access road to one of the Florida camps. The entire area in that vicinity is sand. A mixture of bitumen and sand is made on the road by means of a traveling mixing plant. The sand present in the road is being used as aggregate with the only imported material the bitumen for the binder.

Under some conditions a bituminous surface treatment of the foundation may be all that is needed. Certainly if the foundation is sufficient to support the weight of the traffic expected, then a thin bituminous surface will make the top waterproof and take care of the abrasive action of traffic. Surface treatments done in too cold or too wet weather, however, are usually not very satisfactory. If the work can be done under favorable weather and climatic conditions a bituminous surface treatment may be entirely adequate.

The treatment of the wide shoulders is also another problem which must be solved. The shoulders need not be strong enough to carry continuous traffic but they must be of sufficient strength to support disabled or parked vehicles and also to carry traffic past broken down vehicles which may be stalled on the pavement. They must serve this purpose in all kinds of weather. Evidently only a very exceptional road soil would be satisfactory without treatment of some sort. Gravel or macadam, or in some instances selected earth, can be used to build entirely new shoulders. To do this, the existing road soil must be excavated and disposed of to provide space for the new material. In some cases it may be possible to raise the pavement surface and place the new shoulder material on the existing shoulder. This plan can often be used where a new bituminous mixed surface of appreciable thickness is being placed on an existing road. While the untreated gravel, macadam or selected soil shoulders may be fairly satisfactory for awhile, they will require a bituminous treatment to protect and water-proof the surface. Generally this treatment should be given during the first summer the shoulders are in service.

The existing soil in the road shoulders can be conserved by the use of one of the types of bituminous base stabilization. This has been done successfully on state highways and many times will be the most satisfactory and economical solution of the shoulder problem. The methods used for the bituminous base stabilization of roads and airport runways can be used without modification for shoulders. These stabilized shoulders are only bases and must be protected with a bituminous top. In most instances, a bituminous surface treatment or seal coat will be sufficient.

One factor that cannot be neglected in access military roads is drainage. It is of vital importance to have the sub-grade adequately drained and sufficient facilities must be provided to take care of the surface water efficiently and promptly.

The problem of the access military road is not greatly different from any other road built under similar conditions. Standard types of pavement can be used for entirely new contruction. For strengthening, reconstruction and shoulder construction, bituminous surface treatments, bituminous base stabilization and bituminous road mix, traveling plant mix and central plant mix are all types and combinations which can be used to successfuly solve the access road paving problem.

Chicago's Southwest Plant to Be Doubled in Size

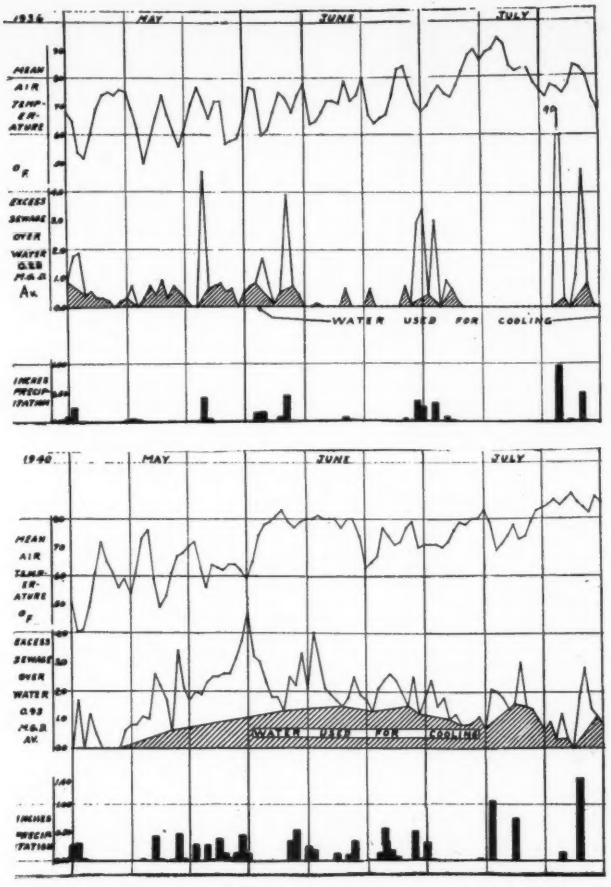
Facilities at Chicago's 400 mgd. Southwest sewage treatment plant will be expanded to handle an additional load of 500 mgd. Construction work at the plant, which is already the world's largest complete treatment works, is being divided into two stages. The first stage will add 100 mgd. capacity to the existing plant through the addition of final settling tank and blower facilities and will cost $3,800,000. The second stage, the 400 mgd. addition, will include the construction of primary and final settling tanks, aeration tanks, and extensions to present pumping, blower, and sludge disposal facilities.

This enlargement program is the culmination of plans made some 15 years ago to give complete treatment to all sewage from Chicago and 60 suburban towns and cities under the jurisdiction of the Sanitary District of Chicago.—*Am. Public Works Ass'n.*

Estimating Water Used for Air Conditioning

By E. E. SMITH

General Superintendent, Department of Water and Sewage Treatment, Lima, Ohio.



Graphs for 1936 and 1940, showing mean air temperature and precipitation, and estimated cooling water.

RECENT technical literature has offered considerable speculation on the subject of the effect of air-conditioning upon water consumption and sewage flows. The following is a brief description of how a study of this was made by compiling data from the records of the Department of Water and Sewage Treatment of Lima, Ohio.

A study of the records of operation of the sewage treatment plant for the years 1933 to 1940 indicates a normal excess of recorded sewage flows over water consumption. The population according to the 1930 census was 42,287, which had increased to 44,694 in 1940. The water consumption in 1933 was 4,187,000 and in 1936 was 5,030,000; the normal consumption being 4,474,000 gallons or approximately 105 gallons per capita per day.

The sewage flow for the corresponding years has averaged 5,030,000 gallons per day, the excess of sewage flow over water consumption being approximately 560,000 gallons per day.

Lima has a combined sewer system and it is important to eliminate storm flows from total sewage flows in order to estimate the amount of cooling water added to the sewers from private sources. Since the temperature of the public supply in the distribution system always exceeds 70° during the months May to September inclusive, reaching a peak of 84° in August, it is obvious that a large amount of the cooling water during these months will be obtained from private deep well sources which have a lower temperature.

The accompanying graphs for the years 1936 and 1940 have been prepared from the data referred to. In these the upper line indicates the mean air temperature as observed by hourly readings at the Lima water purification plant. Precipitation in hundredths of an inch recorded on the bottom line of each graph are taken from records of the Standard Weather Bureau rain gauge at the Lima sewage treatment plant. The middle series of lines indicate the excess of sewage flow for any day over the water consumption for the same date, and the cross-hatched section is an estimate of the water apparently added to the sewers from private cooling systems.

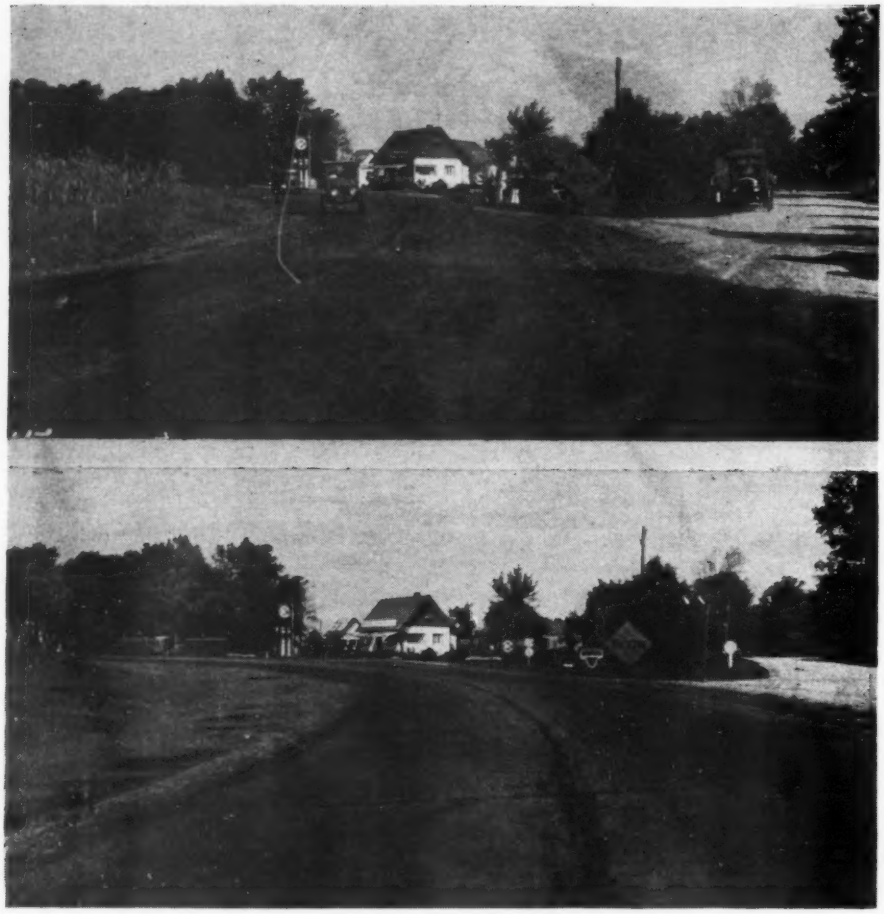
As most of the air-conditioning installations in Lima were installed after 1936, the notable differences between these two sets of graphs would seem to be due largly to the added cooling water, especially as it appears to bear some relation to the observed air temperatures. In 1936 there appears to be a very small amount of water in the sewers not contributed by the water supply, the, only excess of sewage flow over water consumption coinciding with the dates of rainfall run-off peaks, in spite of the abnormally high temperature recorded for the whole summer of that year.

A comparison of the data for the years 1939 (which are not shown here) and 1940 shows that the average excess in the latter year (0.93 mgd) was less than that observed in 1939 (1.12 mgd), indicating that not many more air-conditioning or industrial cooling installations have been made during 1940 and that the lower excess of sewage flows over water consumption conformed to the lower air temperatures.

The above is from a paper presented by Mr. Smith before the Fourteenth Annual Ohio Conference on Sewage Treatment which met at Columbus, October 1 and 2.

Road Oil Production

Road oil produced by the petroleum refining industry in 1939 amounted to 861,772,078 gallons, as compared with 592,556,892 gallons in 1937. Of last year's total road oil production, about 70% was liquid asphaltic road oil with a value of $17,142,266. Production of asphalt other than liquid totaled 2,344,592 tons as compared to 2,971,038 tons in 1937. During those two years the tar output increased from 20,421,403 gallons to 52,029,686, but declined in value from $853,393 to $822,242.



U. S. 30, Marshall Co., before and after widening.

Widening

MANY highways in the State of Indiana, as well as in most States, have been constructed on narrow rights-of-way and with narrow shoulders. This is especially true in this State with respect to highways constructed prior to 1933 or 1934, when the State Highway Commission of Indiana started the policy of constructing wide shoulders on relatively wide rights-of-way, the roadway section adopted at that time providing for a twenty-foot width pavement with eleven-foot shoulders on each side and an additional four feet to the ditch line. It is considered necessary that the shoulder width be at least as wide as the traffic lane in order to permit a vehicle to leave the pavement and park on the shoulder in case of emergencies, leaving the pavement open to moving vehicles at all times. This "storage space" adjacent to the pavement provides safer highways and facilitates the movement of traffic. In the event it becomes necessary that the highway be used for defense purposes, easy and rapid movement of this traffic with safety will be of primary importance and thus ample width of shoulders is vitally essential.

Shortly after the Commission adopted a policy of building wide shoulders on new projects, they also inaugurated a program of widening the shoulders on many of the then existing highways with narrow shoulders and narrow rights-of-way, and at the present time very few of the primary routes remain with narrow shoulders.

Three Steps in Shoulder Widening

There are three principal phases of a program of shoulder widening, any of which may present difficulties. These three principal phases are: acquisition of additional right-of-way; the lengthening or extension of existing structures; and finally the construction of the wider shoulders.

The acquisition of additional width of right-of-way is probably the most difficult of the problems encountered. The owners of property adjacent to the highway are prone to consider the existing facilities as entirely adequate and are, therefore, reluctant to allow the State to acquire additional width at a reasonable cost. Frequently, however, the additional width can be secured rather easily except for the portion immediately in front of residential buildings bordering the highway. The problem becomes very difficult in built-up areas adjacent to cities or towns. In a few cases where the extreme cost of such right-of-way seemed prohibitive, the State Highway Commission of Indiana has skipped or omitted such localized areas from the program of shoulder widening with the hope that the additional width of right-of-way could be secured at a more reasonable cost at some later date. In general, right-of-way costs tend to increase rather than to decrease and it is doubtful if, in very many cases, the additional width can be secured more economically at a future date. Such offsets in right-of-way and gaps in widening improvement are a source of hazard and do not present a pleasing appearance, and should be held to an absolute minimum.

After the necessary right-of-way has been secured, the actual work of lengthening structures and of widening the shoulders can begin. This work may be done either by force account or by contract. The State of Indiana has used both methods. We have found that the contract method usually proves more satisfactory for the lengthening of structures; while, on the other hand, force account has proved to be very satisfactory for the actual widening of the shoulders.

Contract or Force Account

Where the work is to be handled by contract, sufficient data must be secured to determine the quantities involved to a fair degree of accuracy prior to the preparation of the contract. If structures are involved, an inspection of all existing structures should be made. Many of these existing structures will be found to be obsolete, or in such a condition that they must be re-

# of Shoulders on Main Highways

By EARL B. LOCKRIDGE
Acting Chief Engineer, Indiana State Highway Commission

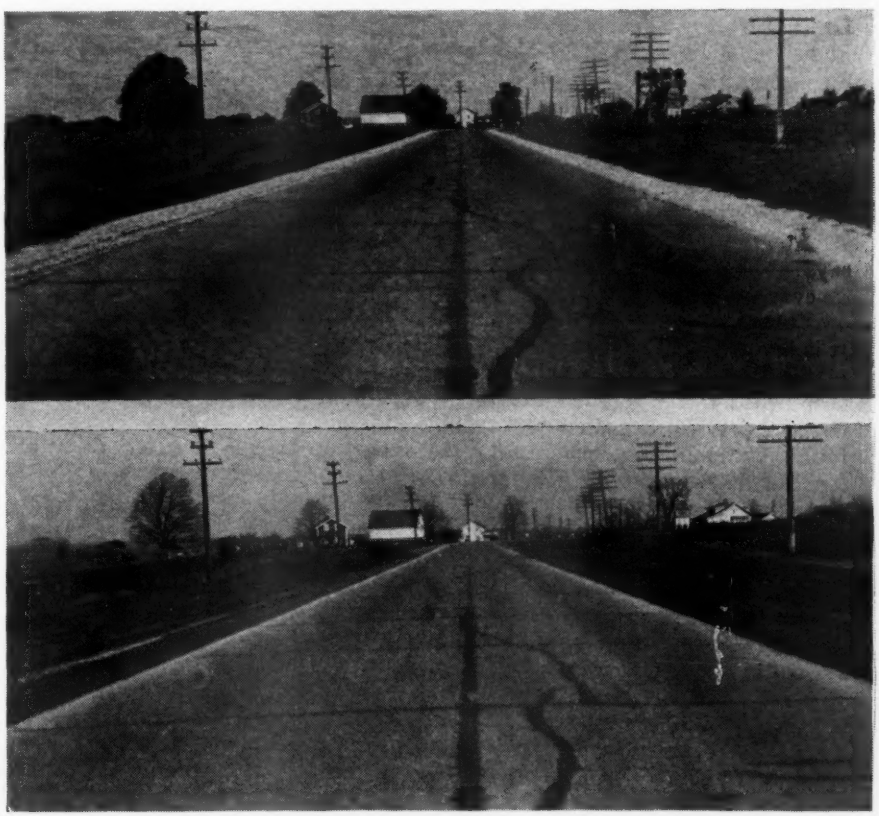
Important for providing turnouts and storage space. The three principal phases in widening highways.

placed; while others can be extended, or lengthened, so that they will give many more years of satisfactory service. Economical considerations frequently determine whether a certain structure should be replaced or repaired and lengthened. Where the waterway area of the existing structure is inadequate, the condition should always be corrected. The estimate of the quantity of excavation and of incidental items should be sufficiently accurate to insure intelligent bidding.

When the force account method is used, prior determination of quantities is not so important, although data must be secured sufficiently in advance of actual operations to insure intelligent and economical handling of materials. Frequently, considerable extra work may be involved if the work is not planned in advance. This is especially true regarding excavation, where the nature of the work makes balancing of excavation quantities very difficult. Where excavation quantities are relatively small, the force account method, using W.P.A. labor, has proved very satisfactory. With the increase in industrial employment due to the extensive preparedness program and general business pickup at this time, the availability of W.P.A. labor will probably decrease, thus making the force account method less practical for the time being. The inherent flexibility in force account compared to contract work is a definite advantage in the program of shoulder widening when early inauguration of the program is considered essential. On the other hand, lower costs can frequently be secured through contract and both features must be considered.

Widening or Reinforcing Existing Pavement

Although the acquisition of necessary right-of-way, the lengthening of structures and the excavation are major items involved in a program of shoulder widening, the engineer will be faced with many other problems. Where the pavement itself is narrow, it may be desirable to widen the pavement. Such widening of the pavement surface is essential where the existing pavement is not wider than sixteen feet and is desirable at many locations where the width is eighteen feet, since sixteen or eighteen foot pavements are scarcely adequate for two lanes of traffic when the traffic consists largely of heavy vehicles. The widened portion of pavement need not necessarily be of the same type as the existing pavement, although such would normally be desirable. If the existing pavement is rough and in poor structural condition it may be desirable to resurface, thereby gaining strength and riding qualities as well as safety by added width. In certain locations, where it is anticipated that traffic will be extremely heavy, conditions may justify the actual stabilizing or surfacing of the shoulder itself in order to provide all-



Road No. 31 in Marshall County, before widening (above) and after widening.

year service for the emergency parking of heavy vehicles.

In built-up areas it may be feasible to construct a curb section (city type construction) in order to avoid the acquisition of expensive right-of-way. The intelligent use of guard rail may reduce the hazard where it is not considered economical to acquire sufficient right-of-way or where structures or other features are of such nature that it is not feasible to provide full width construction at such locations. There will be many locations where a portion of the existing pavement should be removed and replaced in order to secure satisfactory grade and alignment. In many cases, and more particularly on force account construction, the engineer will have the opportunity to improve the appearance of the highway by utilizing a warped section as needed at certain spots to preserve existing trees and shrubs if they are not so located as to be hazardous. The construction of flat slopes and seeding or sodding are always highly desirable. Landscaping can often be done in conjunction with the widening operations with only a very nominal increase in cost.

The entire work should be so planned that traffic on the highway may be maintained while the work is in progress, and adequate arrangements should be made for the safe handling of such traffic. Each location will present features requiring special study in order to arrive at an economical and practical solution. Satisfactory completion of a shoulder widening project will often depend on the ingenuity and resourcefulness of the engineer in charge of the actual operations.

A Study of Evaporation From Water Surfaces

CONTINUOUS records of precipitation, runoff and evaporation from a small southern water shed, 0.8 sq. mi. area in and adjacent to Baton Rouge, La., have been collected since 1933 by cooperation of Louisiana State University and the U. S. Geological Survey, and a summary of the data through 1939 has been published by the University.

Evaporation from both land and water was studied, and concerning the latter some interesting conclusions are given in the report. One of these relates to the importance of temperature readings of the water as well as of the air. The author, Prof. Glen N. Cox, says: "The temperature is a very important factor in evaporation studies, due to the increase in vapor pressure which accompanies a rise in temperature. It is here considered that the evaporation is a function of the difference between the vapor pressure as determined by the relative humidity and that which would exist for saturated vapor. This difference was found by taking the product of the vapor pressure for the daily mean air temperature and one minus the mean relative humidity for the day. In this computation, the relative humidity was expressed in decimal form.

"The daily wind movement was considered due to the fact that a strong wind sweeps the saturated vapor away and replaces it with relatively drier air. Logically then, the evaporation should increase with greater wind movement.

"During the early stages of the investigation it was found that a sharp drop in temperature was always accompanied by a great increase in the rate of evaporation. For this reason, a recording thermometer was installed for obtaining a continuous record of the lake temperatures. The City Park Lake is shallow and the mean water temperatures are generally higher than the mean air temperatures. The effect of the temperature difference upon the rate of evaporation is a very important factor, and has seldom received its proper consideration. The author does not know of any case where other authors have incorporated it directly in their published equations.

"The following empirical formula was developed for the U. S. Geological Survey type floating pan made of copper:

$$E = (V.P.D. + 0.016\ T.D.)\ (0.564 + 0.051\ T.D. + \frac{W}{300})$$

in which E is the evaporation in inches per day, V.P.D. is the vapor pressure difference at the mean air temperature (V.P.D. is obtained by taking the product of the vapor pressure at the mean air temperature and one minus the mean reative humidity expressed as a decimal), T.D. is the temperature difference which is found by subtracting the mean air temperature from the mean water temperature, and W is the wind movement in miles per day measured about three feet above the water surface."

Milledgeville's Reconditioned and Improved Filter Plant

The water filter plant of Milledgeville, Ga., has been reconditioned and improved. Lamar Ham, Superintendent of Water Works, and W. C. Hartman, Superintendent of Filtration and Plant Operator, are now completing the final details on this filter plant reconditioning job, according to the *Georgia Faucet.*

Fishing Creek is the source of raw water. The existing earthen raw water storage basin remained as is during this reconditioning work. The new unit consists of a coagulating basin of the gravity type with over and under baffles, a settling basin and one rapid sand filter having approximately a 350 g.p.m. capacity. The filter house which previously housed the single existing filter has been enlarged to include a full size operating floor, a laboratory with provision for chemical and bacteriological control and a pump room floor suitable for housing all pumping equipment. The present clear-water storage basin will be used as it stands.

This plant is notable in that it will be one of the first in Georgia to install the new Palmer wash system for cleaning filter beds. Also the new filter bed uses Anthrafilt as a filter medium.

Sewage Treatment in Colorado

On January 1, 1934, only five Colorado communities, with a total population of 15,203, gave their sewage complete treatment, and seventeen communities with a combined population of 21,873 employed primary treatment. Then the people were aroused to the danger, as shown by high mortality rates of typhoid, enteritis and diarrhea, and by January 1, 1939, 83.1% of the sewered urban population of the state was treating their sewage or had plants under construction. Since Jan. 1, 1934, primary treatment has been installed in 13 communities with 37,365 population, and complete treatment in 13 other communities with 426,070 population. To give treatment plants to every sewered community in the state would require 57 more plants serving a total population of 101,361.

The Editor's Page

Bridges, Weak Links and Bottlenecks

"A chain is as strong as its weakest link," and the traffic capacity of a highway is limited to that of its most constricted bottleneck. A highway may have the most durable kind of surface on the most solid foundation, but the maximum weight of truck that can travel over it may be limited by a weak bridge to only a fraction of what the road could carry with perfect safety. Such a bridge renders useless much of the money spent in constructing the road, until replaced by one of maximum standard capacity.

There are hundreds, possibly thousands, of bridges that are just such weak links. The Division of Highways of California reports that 700 of the 1500 bridges on the Federal military highway network in the State are inadequate for defense needs, 430 of them inadequate in either width of roadway or alignment of bridge and approach roadway, the others with strength below the load limit of the vehicle code. Altogether about 1200 of the 4200 State bridges are "not up to an acceptable standard, and the general condition of 8000 or more bridges on county roads is known to be a still more serious problem." Unfortunately this is not an exceptional case. Many states know that their bridges are in equally unsatisfactory condition; in still other states definite knowledge on the subject is lacking.

A too-weak pavement may become rough, may even disappear altogether in places under severe traffic; but even then the heaviest truck or military traffic *can* get through at the expense of lost time and an occasional broken spring. But when a bridge breaks down, there is likely to be a total loss of trucks and lives, and it may be days before even makeshift passage across the stream can be provided, and months before a permanent structure can be erected.

Until all bridges on a highway are up to the standard load adopted for it, returns from money spent on bringing the pavement up to standard will be deferred or only partial. Since bridges are such an important part of a highway and so much time is required to replace inadequate ones, the first aim in highway preparedness should be to thoroughly inspect all bridges, especially those on the military highway network, to discover which ones are inadequate in strength and width, and take immediate steps for making them adequate. This, it seems to us, is the most pressing and important duty before all State highway departments which have not already done so; and the next or simultaneous one is to eliminate all other bottlenecks.

Lay In Water Supplies Now

As our preparedness program gains strength, most of the metal working plants throughout the country will find themselves swamped with orders; and later the railroads will find their rolling stock inadequate for the freight to be handled. Meantime prices for steel and iron products will advance, if the history of 1918 is any criterion. The wise water works department will order at once all the supplies they are likely to need for the next year or two. And that goes, to a less extent, for the highway, sewer and other municipal departments.

Speed Is Less Important Than the Final Results

With so much emphasis being placed on speed in construction—whether this refers to roads, airports or the finished material of defense — there is serious danger that quality will be sacrificed. In highway construction, the use of antiquated road-building equipment and guessing about the proportions or the characteristics of the materials used, whether these be local soils and aggregates, cement or tar or asphalt, is sheer waste that we all will pay for later on. In the battlefront areas of Europe and Africa, speed may be all important. As yet, in this country, it is far better to take the few extra hours and the added effort to produce a structure of proper and careful design; and then to build it with modern equipment. We cannot afford to mix concrete for highways by hand, to spread bitumens with the old sprinkling pot, to use lightweight graders on heavy-duty construction, to omit rolling when proper compaction is an essential in construction. If we yield to such shallow thinking we will find that our roads will fail very quickly under the pounding of our modern heavy and high-speed traffic and in a short time they will have to be rebuilt; and they are likely to fail under the very emergency for which they were so hastily prepared.

It is interesting to read the records of 1917; in the course of a solemn conference in September of that year, it was deemed better to have sub-standard sewage plants installed by February than to have standard-type plants available by May. The cold records of that period now show that many of the sub-standard plants—the Doten tanks—had failed before May and that thereafter operation was a serious problem; some of these plants were rebuilt, while others were allowed to stagger on, a continuous pain in the neck. Nevertheless, in the early fall of 1940, it was again solemnly decided that speed was an essential and plans were made to go ahead on the same basis of sub-standard treatment plants. The protests of the state sanitary engineers and of others interested in preventing the waste of money and the establishment of nuisances at the various camps have brought about a saner view and for the most part modern and well-designed plants are being installed.

A broken-down highway or an inadequate sewage plant represents a waste of the initial investment, a continuing drain in maintenance and operation, and a liability so far as its ability to perform its intended function is concerned. It has been shown that a physically handicapped soldier is a liability; he needs more care and attention than he is worth; he is better out, and a good man in his place. The same truth applies in engineering structures. We should have only those physically qualified through careful and skilled design, the use of proper materials in construction, and the employment of adequate equipment to get the most from both design and materials.

General view of Findlay plant. Main building at right; sludge beds and digester at left

The Calendar, the C

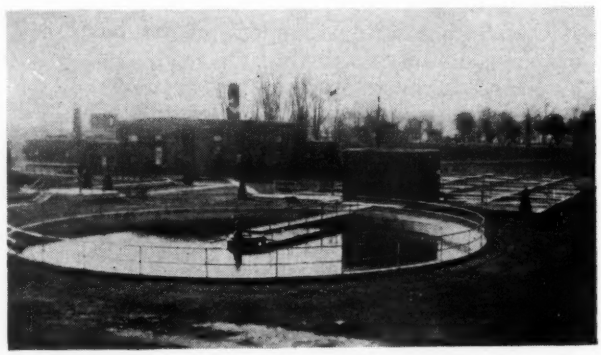
By WILLIAM F. CROHEN
Findlay, Ohio, Sewage Treatment Plant

IT IS fully recognized that, for successful operation of sewage treatment plants, accurate laboratory tests are necessary, and the procedure and methods of conducting such tests are well standardized. But the methods of collecting and handling samples to be tested are so varied that the results obtained by similar standard tests on different samples or at different plants may not be truly representative or truly comparable. In some extreme instances plant efficiency and monthly reports to the State Board of Health are based on one set of catch samples per week.

Some effort has been made by a few members of the Northwestern Ohio Conference on Sewage Treatment to standardize the methods of sampling and the procedure in preparing composite samples for laboratory tests; their opinion being that enough individual samples should be taken to give a fairly accurate representation of the changes in concentration of sewage solids throughout the sampling period, and that the amounts of the individual samples that are used in making the composite should be proportional to the sewage flow.

In order to get a true picture of the changes that take place in sewage solids concentration and biochemical oxygen demand, and to learn what effect the time of day, week or month has on catch samples, the writer made a study of the subject extending over the period of a year, using for this purpose the sewage entering the Findlay plant, employing a method that we had never seen used before.

The figures given in the accompanying tables are the results of daily routine laboratory tests. Each test was made on a composite sample made up from twelve individual samples taken at the regular sampling stations every two hours throughout the 24 hours, the amount of each sample being proportional to the sewage flow at the time the sample was taken, as indicated by the record on the flow meter chart.



Final settling tank, aeration tanks and control house; primary settling tank and main building at left.

Studying the Analyses

The results of the daily sampling were tabulated under the headings shown in Table I—"Raw Sewage Suspended Solids," "Raw Sewage B.O.D.," etc.—and at the end of the year these were combined to obtain the averages for each month and the maximums and

TABLE I

		Dec.	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May.*	*Jun.*	*Jul.*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Av. Yr.*
Raw Sewage Suspend. Solids	Avg.	189	198	113	86	143	134	149	267	165	238	535	705	243.3
	Max.	603	520	204	156	273	250	403	989	273	473	852	1208*	
	Min.	72	67	67	40	34*	94	69	64	92	128	87	266	
Raw Sewage BOD	Avg.	247	268	116	90	109	158	137	183	221	249	458	531	230.5
	Max.	421	435	261	132	177	277	191	380	363	319	975*	929	
	Min.	110	137	65	52*	55	102	75	86	119	177	113	232	
Final Effluent Suspend. Solids	Avg.	6	15	8	4.5	3.4	6.3	8.5	10	7	17	22	8.5	9.7
	Max.	13	31	25	17	12	29	21	49	20	110*	54	16	
	Min.	0*	2	0*	0*	0*	0*	0*	0*	0*	0*	2	0*	
Final Effluent BOD	Avg.	30	25	9	5	5.4	4.2	4.6	6	11	11	34	28	14.4
	Max.	48	59	17	16	11	7	9	10	24	19	75*	58	
	Min.	5	5	4	3	3	2*	2*	3	3	6	6	3	
% Removal	S.S.	96.8	92.4	92.1	92.4	97.6	94.4	92.5	96.2	96.0	92.8	95.9	96.7	96.0
	BOD	88.0	90.7	92.2	94.2	95.0	97.3	96.9	95.9	95.0	95.6	92.5	89.9	93.7
Average Flow.....mgd.		1.77	2.06	3.15	3.21	3.53	2.87	3.22	2.53	1.99	1.91	1.57	1.33	2.21
Monthly Precip...in.		1.36	2.31	3.89	3.69	4.28	.48	9.06	3.60	2.41	2.57	3.65	.51	

Clock and Sewage Samples

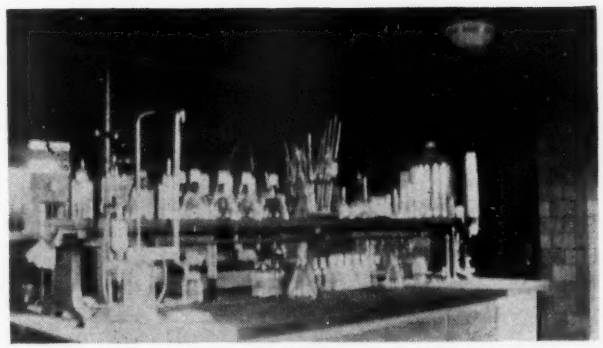
Effect of time of day, week or month on catch samples and how to allow for them in analyzing sewage and effluents.

minimums for each set of tests. These are the figures shown in Table I.

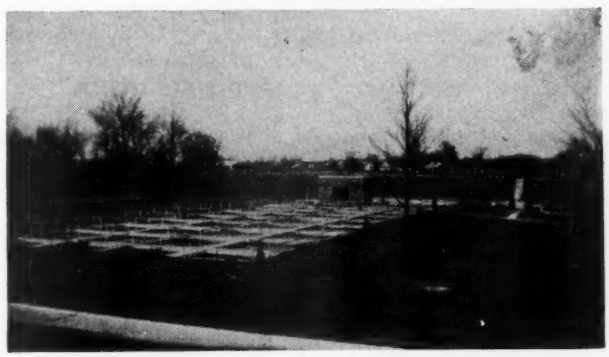
Raw Sewage Suspended Solids. In comparing the monthly averages under the heading Raw Sewage Suspended Solids, we find the lowest monthly average figure was in March, being 86 ppm, and highest, 705 ppm, was for November. It is important to note that these are monthly averages, and the spread between 86 ppm and 705 ppm represents the variation in concentrations over a period of twelve months. Only three of the monthly averages exceeded the yearly average of 243.3. During November, the month of maximum concentration, the average was 819% of the average for March, the month of least concentration. The daily figures, of course, give a much wider difference between minimum and maximum, the range for the entire year being between 34 ppm and 1208 ppm. It happened that the day of highest concentration was during the month with the highest monthly average, and that this month had the lowest monthly precipitation.

Raw Sewage B.O.D. Studying the figures for five-day B.O.D. tests of raw sewage, we find the lowest monthly average, 90 ppm, was in March, and the highest, 531 ppm, in November, coincident with the lowest and highest average suspended solids. The lowest daily figure, 52 ppm, occurred in March, and the highest, 975 ppm, in October, this being 1870% of the minimum. The yearly average, 230.5 ppm, was exceeded by five of the monthly averages, that for November being 230% of the yearly average and 590% of that for March, the lowest monthly average. The daily figures show even greater variations throughout the year.

Final Effluent Suspended Solids. The Final Effluent figures are more consistent and there is less difference between the averages. Taking the figures for suspended solids, the lowest monthly average is 3.4 ppm, for April,



View of laboratory work bench; fume hood in far corner.



Aeration tanks, control house and final settling tank.

TABLE II

Suspended solids by days

	Raw Sewage			*Final Effluent*		
	Avg.	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*
Sunday	183	674	34	5.5	18	0
Monday	317	989	57	11.7	54	0
Tuesday	235	1061	64	7.3	29	0
Wednesday	239	1208	66	12.0	96	0
Thursday	241	778	36	13.5	110	0
Friday	217	866	66	7.7	31	0
Saturday	317	821	75	10.0	21	0

B O D by days

	Raw Sewage			*Final Effluent*		
	Avg.	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*
Sunday	182	455	52	11.4	42	2
Monday	318	929	78	18.7	75	2
Tuesday	226	800	62	16.2	58	3
Wednesday	233	893	64	16.4	50	3
Thursday	230	602	55	18.2	59	3
Friday	237	753	85	10.3	35	3
Saturday	282	975	108	13.7	47	2

and the highest is 22 ppm for October. The yearly average is 9.7 ppm; thus the lowest monthly average is 35% of the yearly average, and the highest is 227%. The daily figures range from 0.0 ppm to 110 ppm.

Final Effluent B.O.D. The monthly averages of final tank effluent B.O.D. varied from a minimum of 4.2 ppm in May to a maximum of 34 ppm in October, and the yearly average was 14.4 ppm. The lowest daily was 2 ppm, which occurred in both May and June, and the greatest was 75 ppm, occurring in October. During the entire year there were four months whose averages exceeded the yearly average.

Percent Removal. Over the period of study the percent removal figures were very consistent and there was very little difference between the monthly and yearly averages. The yearly average removal of suspended solids was 96%, the minimum was 92.1%, for February, and the maximum was 97.6% for April. In the removal of B.O.D. the yearly average was 93.7%, the minimum was 88.0% in December, and the maximum was 97.3% during May.

Tabulation by Days of the Week

Table I shows that November was the month of heaviest loadings of suspended solids and B.O.D., and March the month of least concentration, and the other months can be rated by their ratios to the yearly averages. This month-by-month study gave considerable information regarding the fluctuations and variations in the sewage loadings and concentrations, but more could be learned by comparing the different days of the week. This was done by using the same daily laboratory test results but tabulating them under the day of the week on which the sample was taken. Table II shows the averages for each day of the week for the entire year.

We had always thought that the loadings of suspended solids and B.O.D. on Mondays were the most concentrated received at our plant, due to the large amount of soapy wash water, which was always in such large volumes on Monday as to color the entire sewage flow and the movement of flow through the flumes caused quite a large amount of suds to form. We were surprised therefore to learn that Saturday's raw sewage suspended solids, 317 ppm, equalled Monday's, both being more concentrated than the other days of the week. Monday's B.O.D.was slightly higher than Saturday's. Sunday's flow was the least concentrated.

This table brings out the difference that it makes which day of the week the samples are taken. Raw sewage samples taken on Mondays and Saturdays are higher in both suspended solids and B.O.D. than the yearly average, while those taken the other five days are lower. It is interesting to note how closely related the raw sewage suspended solids are to the raw sewage B.O.D., and also the suspended solids to the B.O.D. of the final effluent.

How Good Are Catch Samples?

Up to now in this study, we have torn twelve pages off of the calendar and have month-by-month averages showing the changeable characteristics of sewage solids concentrations and bio-chemical oxygen demand; and also have averages showing how these properties of sewage differ from day to day. All of these results have been from tests of composite samples, and although showing great variations and differences throughout the year, they do not begin to show the wide variations that would result from purely catch sampling. In order to bring out that phase of our study, it was necessary to do considerable extra laboratory work on catch samples; and although this part is not as complete as we would like to have it, there is enough information to show just what influence the clock has on catch sampling. We would have preferred to run more samples each day, but were prevented from doing so due to lack of incubation space and the extra work involved. For this part of the study, we decided to use only catch samples of raw sewage entering the plant, after being screened, and to use two samples each day, taken twelve hours apart, and samples at such times as to be fairly representative of low flow and low concentrations, and the high flow and heaviest concentrations. Arbitrarily we picked the hours of 5:00 a.m. and 5:00 p.m., and caught the samples at our regular raw sewage sampling station along with our regular samples, which are used in making up the daily composite samples. We ran suspended solids and BOD tests on these catch samples for a period of five weeks. In tabulating the results, we found that the average suspended solids of the 5:00 a.m. samples was 32 ppm and the average BOD was 28 ppm. The average suspended solids of the 5:00 p.m. samples was 332 ppm and the average BOD was 308 ppm. Here, we have the average suspended solids in the sewage flow at a certain time of the day 1000% of the average suspended solids in the flow just twelve hours earlier in the day, and the BOD of the more concentrated sewage 1100% of the lesser concentrated. Over the entire period of these tests, the minimum suspended solids found in the 5:00 a.m. samples was zero ppm, and the maximum for the 5:00 p.m. samples was 544 ppm. The minimum BOD for the 5:00 a.m. samples was 4 ppm, and the maximum BOD for the 5:00 p.m. samples was 675 ppm. Since the suspended solids and BOD loading of the sewage would increase after 5:00 a.m., and begin decreasing after 5:00 p.m., it is apparent that the characteristics of any catch samples taken in between these hours would depend very much on the clock.

Up to this point, this article has been devoted to figures showing the variations and fluctuations in the concentrations of sewage solids and bio-chemical oxygen demand from month to month, and how the loading characteristics vary for each day in the week, and the extremes that can be found in just one revolution of the hour hand on the clock. And, due to these erratic and irregular characteristics of sewage solids, we do not think that plant efficiency or percentages of removal could reliably be based on the results of catch samples. Right here it might be inserted that many of the methods of sampling now practiced are no better than catch sampling—may even be termed catch sampling as there are not enough individual samples to give a composite sample that would be representative of the flow.

How Catch Samples May Be Valuable

With all this evidence against catch samples, they can be very useful under certain conditions. For instance, there are times when the sewage is heavily loaded with certain industrial, milk processing and dairy wastes. Tests for solids and BOD on these particularly heavy loads will furnish a great deal of valuable information for the plant operator. In the regular laboratory procedure, we have found cases where milk waste in the sewage entering the plant had a BOD of nearly 1600 ppm, this figure being 800% of the BOD of the composite sample for that day. Also

(Continued on page 36)

Fig. 2 a—Turnouts constructed at intervals pending building wider shoulders, Vermont, 1940.

The "Bottlenecks" of Our Highway System

Importance of eliminating everything that interferes with needed lateral movement of traffic, to avoid deceleration of traffic flow.

By BERNARD E. GRAY

THE current suggestion for large expenditures on so-called "Defense Highways" has brought forth a variety of plans for procedure. In some quarters the possible availability of such funds has been seized upon as an excellent opportunity to carry through some local pet scheme of development without any real thought as to its true defense value. All too often this is merely the reconstruction of an existing road as a boulevard type, on the ground that a "bottleneck" will be eliminated, whereas the construction is found to create two bottlenecks where only one grew before.

The American Highway System is far from furnishing for modern traffic the ideal development made possible by our present knowledge of the technique of road building, with super-super highways, perfect grade separations and all the rest; but quite aside from the serious question as to the ability of the super highway to remedy all traffic difficulties, it should be obvious that expediency alone is against any such planning other than in a very few instances. How much time will be available for preparing national defense is anyone's guess, but certainly the more that can be done in the next twelve months the better, and the next two years will probably tell the story one way or another. Also the writer ventures to assert that the present easy going assumption of a continuous surplus of all kinds of materials, equipment and labor for any kind of construction will prove completely fallacious, and highway plans therefore should contemplate,—(a) the greatest possible use of local materials, available within short hauls, (b) the salvage of every existing highway value through reconstruction and improvement, rather than replacement, and (c) the combined use of unskilled labor least likely to be employed elsewhere, with the skilled operator of efficient equipment to achieve rapid results.

An early highway commissioner in West Virginia once remarked in those poor-road years that even the worst roads were not bad all the way, but that it was the mudhole here and there which made the whole road sometimes impassable. And so it is with our modern road system; it is not necessarily a whole route that needs to be rebuilt but rather those "bottlenecks"—those inadequate places which virtually reduce the whole length of roadway to a less efficient level.

What is a bottleneck? Anything which interferes

Fig. 2 b—Widening with bituminous concrete on U. S. Route 80, Texas.

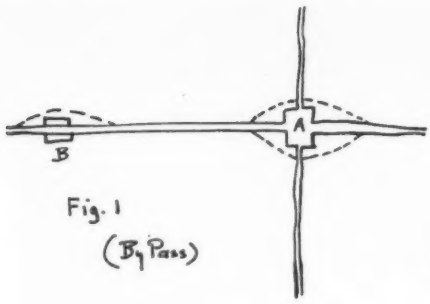


Fig. 1
(By Pass)

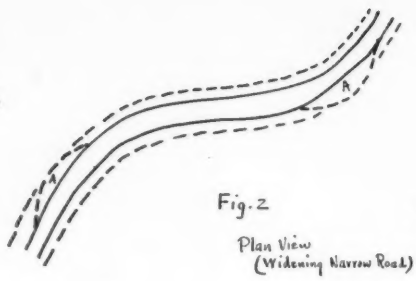
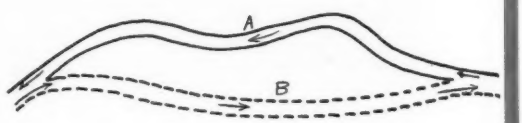


Fig. 2
Plan View
(Widening Narrow Road)

Fig. 3
Plan View
(One way highways)



with needed lateral movement of traffic to avoid deceleration of traffic flow. It may be:

(1) A town or city
(2) A narrow road
(3) A steep grade
(4) A sharp curve
(5) An intersection
(6) A weak or narrow bridge
(7) A rough or high crowned surface

So far as military traffic is concerned, the remedy for such situations is the same as for civilian traffic. The result of delay, however, may be so serious as to be critical in military operations. In Holland and Belgium, for example, the lack of sufficient roads to permit some separation of military and civilian traffic unquestionably greatly contributed to the disaster which resulted.

In planning work on either the primary or secondary systems, the objective should be to lift the *general average of the whole network* rather than to improve a section here and there to a superior degree and to leave other sections untouched, which would then in themselves become new bottlenecks. The causes of traffic delay previously mentioned are not all of the deterrents to traffic movement but they are the principal ones, and will be dealt with here with view to their most practicable elimination.

(1) *A Town or City*—For a large city this is a major problem and requires most careful study. If there is any justification for the super highway it is in relation to metropolitan areas and their environs. Time will not permit a full discussion of the subject here. However, the thousands of small cities and towns contribute their "bottlenecks" as well, and unnecessarily so. Frequently the selection of certain outlying streets posted for one way traffic will satisfactorily keep through cars away from the congested center, and yet not overcrowd the residential street. "Boxing" the town when two or more routes intersect, or "by-passing" entirely with spur connection is of course the ideal solution. The State of Missouri, for example, has done an excellent job in this direction (Figure 1). It is often possible to obtain substantially these results by building one or more short connections to existing streets, resurfacing the entire length with some form of low cost bituminous type pavement, and obtain traffic relief at a fraction of the cost of a new boulevard.

(2) *The Narrow Road*—This is one of the commonest conditions affecting traffic movement in volume, not confined to secondary roads but found on thousands of miles of state roads in the most populous areas of the country. Such roads are easily overcrowded, not because they are two-lane highways and need additional lanes, but because the two lanes are not efficient. Sometimes the pavement itself is narrow (16 or 18 feet); sometimes the shoulders are only 3 feet wide or less, and sometimes there is a combination of the two. In any event there is only 8 or 9 feet effective width for each traffic lane and it is not sufficient for modern vehicles whenever traffic exceeds a few hundred vehicles daily.

However, the remedy is not an additional lane, but rather widening of the existing lanes and shoulders to provide a minimum of 10 to 12 feet per lane. Such improvement will at once step up traffic flow. If funds are not available to immediately complete work over the entire length of a road, it is desirable first to build turnouts at periodic intervals so that traffic becomes aware of them and utilizes them when stopping. As rapidly thereafter as possible the turnouts are connected in a continuous widened shoulder. Vermont has successfully carried on such work in the past year or two. (Fig. 2 and Fig. 2 a.)

Widening of pavement itself is best carried on with some type of bituminous surface. Two principal types are recommended; (a) a stone or gravel base with surface treatment or penetration; (b) bituminous concrete.

Fig. 9—First step in resurfacing old penetration macadam to take out the crown.

(Fig. 2 b.) In many areas it will be practicable to place stone or gravel bases one year and surfacing the next. This procedure fits in particularly well with W.P.A. programs. The important step is to get started and at least partially remedy the trouble *all the way through,* rather than to start rebuilding on a grand scale at one end, and proceed only by sections.

Virginia has used a method of improving the narrow road which has great possibilities, particularly on main routes in rolling or mountainous terrain. Instead of widening the existing highway, especially where heavy earthwork is involved, the present road is made one way, and a new road for opposite direction traffic is constructed relatively parallel to the old road, but utilizing the most economical location in respect to construction cost. They thus provide what is substantially a four lane road at but a fraction of the cost of a new highway of similar capacity, and in addition provide safe stopping places. (Fig. 3.) The old road

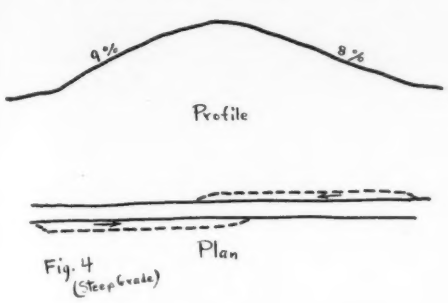


Fig. 4 (Steep Grade)

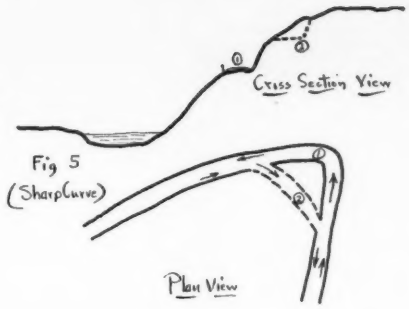


Fig 5 (Sharp Curve)

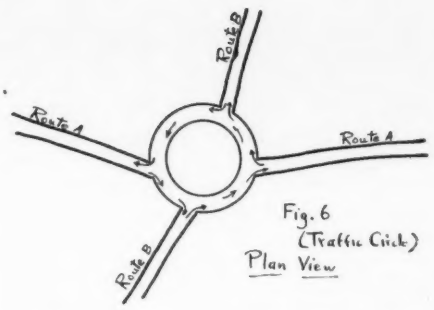


Fig. 6 (Traffic Circle)

can be salvaged as a rule by bituminous resurfacing, and experience has demonstrated that when such work is done in volume the price per ton falls rapidly, making such procedure both rapid and economical.

(3) *The Steep Grade*—A steep grade, if of a length greater than that which a truck can pass in high gear, is a serious traffic deterrent. The remedy is simple, however, and consists of adding an additional lane of pavement on the right up-hill side so that faster traffic passes along smoothly on the inside lane. The widened areas do not need to be constructed at first for the full length of the grade, but should begin where the slowest type truck would have to change to second gear. Later as time permits the lan can be extended to the foot of grade, so that full efficiency from the improvement may be derived. Only here and there does one see this sort of improvement put into effect, yet in hilly country the results are nearly the same as an extra lane of pavement throughout the entire road length. (Fig. 4.)

(4) *The Sharp Curve*—This type of bottleneck takes two forms; one, the simple curve on practically level grade, the other a curve in combination with a steep grade. In the first case, the curve is usually caused by some artificial obstacle which merely reduces sight distance, and the remedy is additional width of pavement and a boulevard strip to separate traffic. In the second case, the curve is present because of natural conditions of terrain and widening is not only expensive but may cause slides in mountainous country. Attention here is directed rather to the possibilities of constructing short sections of one-way roads at these points, and the fact that in the mountains the cost of such improvement will be but a fraction of widening in place. (Fig. 5.) This method is to some extent a short length version of the widening methods described under Virginia practice.

(5) *The Intersection*—All too often we think of a fine clover-leaf grade separation when we think of intersections. These have their place, and at points of great traffic densities are probably justified. It is to be remembered, however, that they are highly vulnerable in respect to bombing, as well as being costly to construct. One of the most effective and inexpensive

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substitutes is the traffic circle, which will effectively distribute traffic to almost any number of intersecting roads, and is capable of easy maintenance and traffic control. In some states attention is being given to obtaining a large diameter traffic circle (up to 500 feet), which provides a central area of as much as five acres, usable for parking in case of necessity. As a rule, however, a diameter of 100 feet is ample for a simple intersection. (Fig. 6.) Massachusetts and New Jersey are typical states employing these methods. Massachusetts, one of the most densely populated and heaviest traffic states in the country, use hot bituminous penetration macadam surfaces almost exclusively for the construction of these traffic circles, as well as for its other heavy-duty pavements.

Another simple improvement that can be made at intersections, and yet usually is overlooked, is the clearing of brush and moving back fences. Why right-of-way lines should intersect at right angles is a mystery, and much congestion would be avoided by mooning all corners so that cars turning can get away from the main flow of traffic before reaching the turn. (Fig. 8.) Turning areas are thereby provided which are often very important in military operations. These areas can be covered immediately with stable material such as gravel, stone, etc., and then later surfaced as becomes practicable. The important consideration is to make them at once useful under any weather conditions.

(6) *Weak and Narrow Bridges**—This is a problem not so readily solved as some of the other bottlenecks, and yet is one which can be vastly reduced in extent by careful attention to possible corrective measures. Thousands of old steel bridges are still in use on our highways, particularly on the secondary roads, which are either one-way bridges or at best barely two-way bridges, and the latter are very vulnerable to damage, especially under emergency conditions. Widening such bridges is difficult and expensive bu in some cases is practicable. At some locations it is possible to construct a ford nearby to permit one-way traffic over the bridge.

Bridges posted for maximum loads of 2 or 3 tons often make a route unusable for general traffic but this condition can be remedied at reasonable expense in many cases. In many of these old bridges the trusses are quite adequate for modern loads (or would be with a little repair) but the floor system is inadequate, having been designed originally for a uniform load condition instead of for the concentrated loads of today. By using a portable electric welding outfit and reinforcing the existing floor structure (particularly in respect to stringers) many of these old bridges can be salvaged with a surprisingly small tonnage of new steel and a few days of time.

*See also article "Widening and Strengthening Bridges" in this issue.

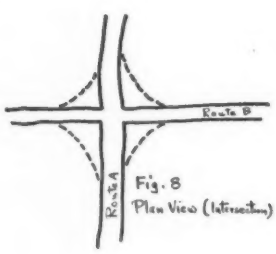

Fig. 8
Plan View (Intersection)

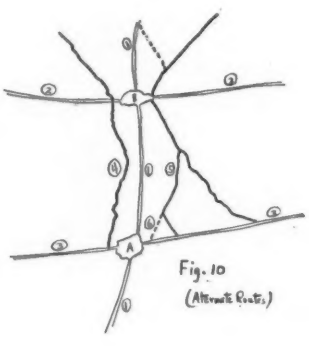
Fig. 10
(Alternate Routes)

The new floor should be of wood, but of a laminated type which will combine lightness and freedom from vibration. One method is to place first a layer of 2-inch plank running longitudinally and well spiked together, then to place a second layer of 2 inch depth, consisting of 2 inch by 4 inch timbers running transversely, spiked together. A surface treatment of bitumen and sand will complete the job, and a thoroughly sound floor structure will result.

(7) *Rough or High Crowned Surfaces*—While perhaps the least of the factors making for delay in movement of traffic, nevertheless surfaces of this character may definitely slow down traffic movement as well as increase maintenance to both road and vehicle. This can be remedied by stage reconstruction, which can be carried on quickly and economically over long sections using either road-mix or plant-mix types of resurfacing. (Fig. 9.)

Conclusion

We talk a lot about defense—most of it is very general—but getting down to cases—what is each one of you going to do about it in the particular job which you hold? Have you thought of the details? Just as an example, if I were back in my old job as a highway engineer, I would be looking at a map of my State and listing the various bottlenecks of the kind just discussed. I would add up for each route the various items needed to bring up the whole length of roadway to an average condition, and weigh the possibility of combining various items of work into the two groups of contract work and force account to work to best advantage. Fig. 10 is a section of a highway map and the conditions are known intimately to me. Just analyze it for a moment. The main highway (1) is overcrowded and there is talk of rebuilding. Such a procedure will take a lot of time and money. It is contended that by improving routes (4) and (5) to their full capacity, route (1) will not require rebuilding and that three alternate routes will be available in event of emergency, instead of one.

It is believed that, in general, a series of approximately parallel roads are better than a single superhighway as a means of serving an area; they are less likely to be put out of commission by bombing or artillery fire; they are less visible from the air; they permit a better circulation net and make for easier adaptation to changes of position or front in time of war. Such a system of roads permits dispersion of traffic instead of its concentration. Effective use of troops and efficient evacuation of refugees requires deployment and room for maneuver, and not dependence upon single super-roads.

Too much wrong emphasis has been placed upon the German success in Holland and France as being the result of the effectiveness of the German road system, especially the super-highway (Autobahnen). As a matter of fact, little or no use was made of them in the attack as they were quite outside either the zone of operations or that of supply. Modern traffic does not require massive roads, but rather *enough* roads and plenty of room to select alternate routes in case of need.

And finally let us not forget that whatever our present road condition, we need not feel too downcast, as no other country in the world even remotely approaches the United States in road facilities available. English and European roads are a terrible problem as compared to ours—they are all "bottlenecks" and no place to go. We at least have room and we have the engineering and labor personnel and the equipment. All we need to do is get busy.

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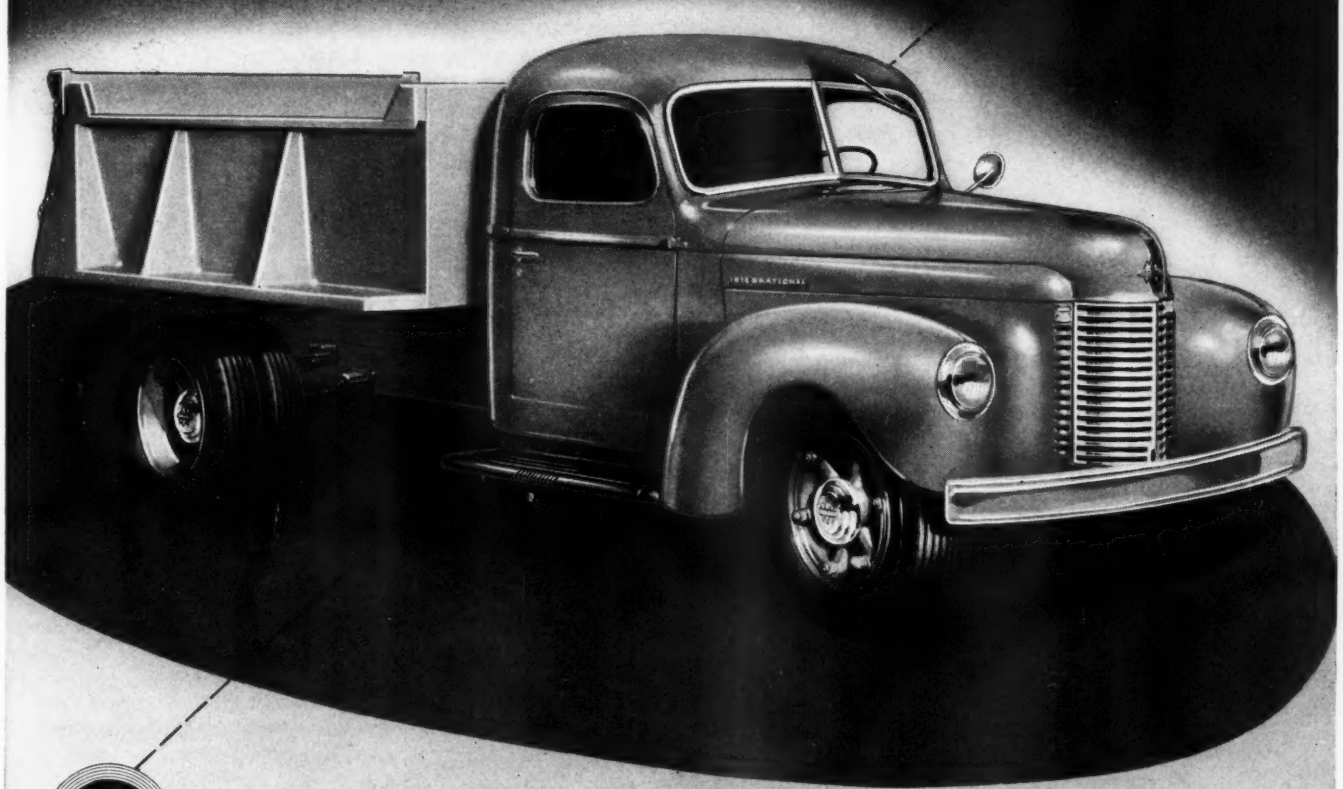

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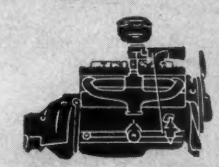

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WPA and the Defense Program

By PERRY A. FELLOWS
Chief Engineer, Work Projects Administration

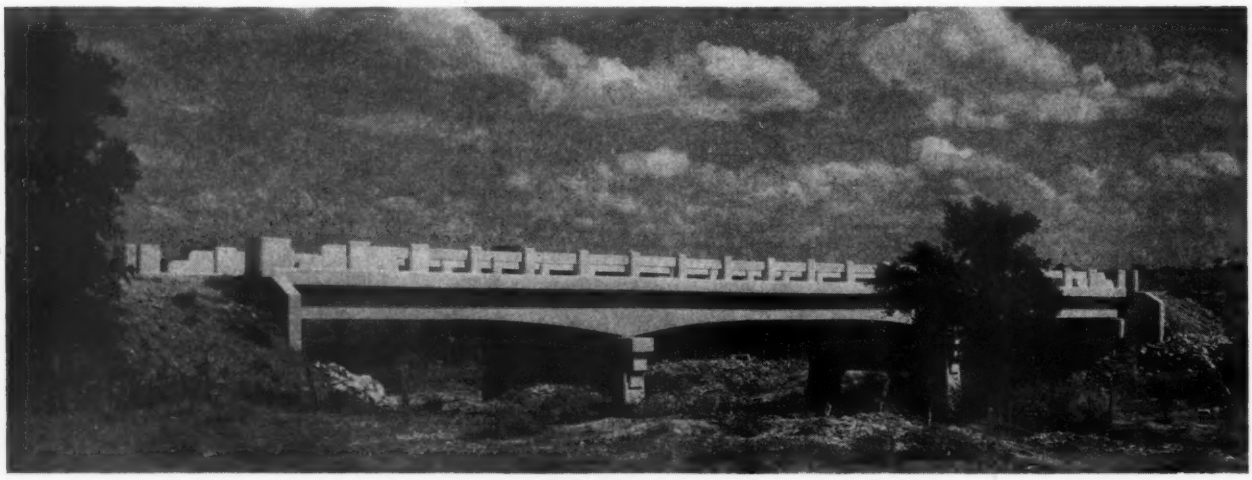
A COORDINATED and successful defense program of public works depends upon the cooperation of Federal, State, and local governmental agencies in planning and operation. The speed and efficiency with which public undertakings important to the defense program can be undertaken and completed will be determined by the nature and degree of this cooperation. It is only by the efficient utilization of the resources of all public agencies that many of the problems in this field can be solved.

At the present time attention is focused upon the needed improvements to the nation's system of roads and airports, and upon problems in the fields of public health, education, public safety and many others that are related directly or indirectly to the national defense program. In many cases these problems are as much of state or local concern as they are of national interest.

The Work Projects Administration, by virtue of its past experience in cooperating with State and local governments, is in a position to assist in carrying out many projects of value to defense. It has done a great deal of such work in the past, and assistance in defense work represents concentration by it on projects of military or naval importance rather than the establishment and initiation of a new program.

The defense work of the WPA falls roughly into two categories—first, projects of the War and Navy Departments which may be operated through a direct transfer of funds to them by the WPA, or under the various state programs of the WPA; and second, those operated under the sponsorship of states, counties and municipalities and by the public agencies of these political subdivisions. Relief labor is used in either event. The majority of projects in the former category are operated at military reservations and naval stations, or are for strictly military facilities. The latter class of projects includes work on airports, access roads to military and naval establishments, roads and highways important for strategic purposes, conservation and health undertakings, and similar types of projects under the jurisdiction of non-Federal governmental agencies.

Projects within the first category mentioned have been designated by the War and Navy Departments as of direct value to national defense. Many projects in the second category have also been certified by the War and Navy Departments as important for military or naval purposes. When a project has been determined by either the War Department or the Navy Department to be important for defense purposes, and has been so certified to the WPA, the ERA Act, fiscal year 1941, authorizes giving it priority over other types of WPA work within a state with respect to the assignment of available relief workers, WPA labor being transferred to such "certified" projects from other operating projects when necessary, insofar as it is practicable to do so without endangering the integrity of work already undertaken.



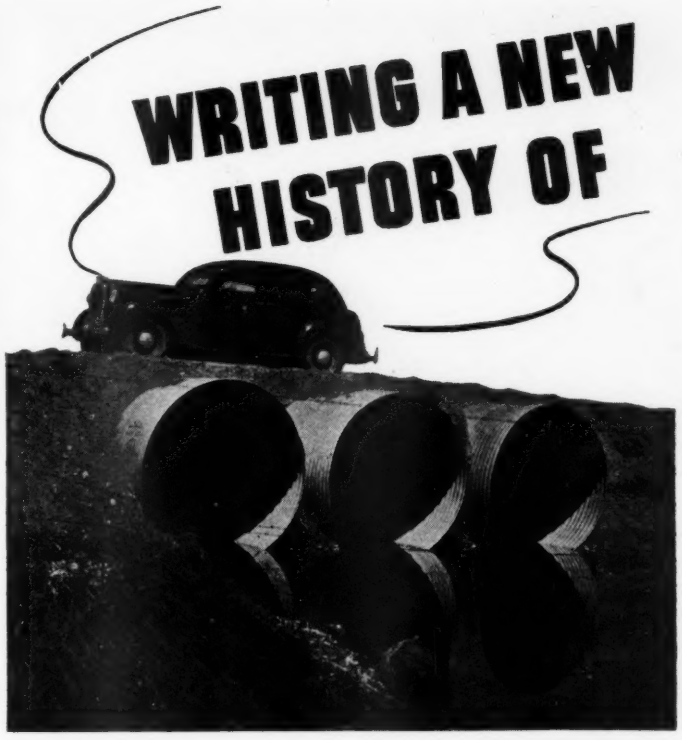
A Tarrant Co., Texas, bridge built by WPA.

WPA Street Improvement.

Also the project may be exempted from the requirement of the current Act that the average sponsor's contribution in each state must equal 25 per cent of the cost of all non-Federal projects. The WPA is authorized by law to utilize only a small proportion of its funds for the purchase of materials, or the rental of equipment. Congress has authorized the use of $25,000,000 of the current relief appropriation to supplement the normal amount of non-labor funds on certified defense projects. However, the WPA funds available for non-labor purposes are able to take care of only a relatively small proportion of the needs of such defense projects, and the sponsors of WPA defense projects must necessarily be prepared to contribute to the extent of their ability, if the projects are to attain their maximum efficiency and effectiveness. This cooperation is being given, as the sponsors realize that the majority of the non-Federal work now in operation or being planned, in addition to its defense value, be of civic benefit and therefore of value to many localities.

Certified defense projects may further be exempted from the provisions contained in the Emergency Relief Appropriation Act relative to the hours of work and earnings of persons employed on WPA projects. It is not expected that recourse will be had to these exemptions under any but the most exceptional circumstances, as, for example, when the skilled workers necessary to complete a project, and who were available on the relief roles at its initiation, are drawn into private employment. In such cases it may be necessary to make adjustments in work schedules and wages in order to assure the completion of a project in accordance with schedules which are vital to the success of military or naval undertakings. However, since the primary purpose of the relief program is to provide employment opportunities for persons certified as in need of relief, and since departures from the established schedule of hours and earnings reduces the number of certified workers who can be employed with the funds available, the WPA would be justified in initiating projects requiring substantial changes of this nature in only the most exceptional cases.

The availability of relief labor will thus determine in many localities the amount of defense work which can be undertaken and the relative speed of execution. In cases where more projects are presented than can be executed with the available relief labor, and where the projects are of comparable priorities as to military importance, preference will naturally be given to those projects on which the greatest sponsors' contributions



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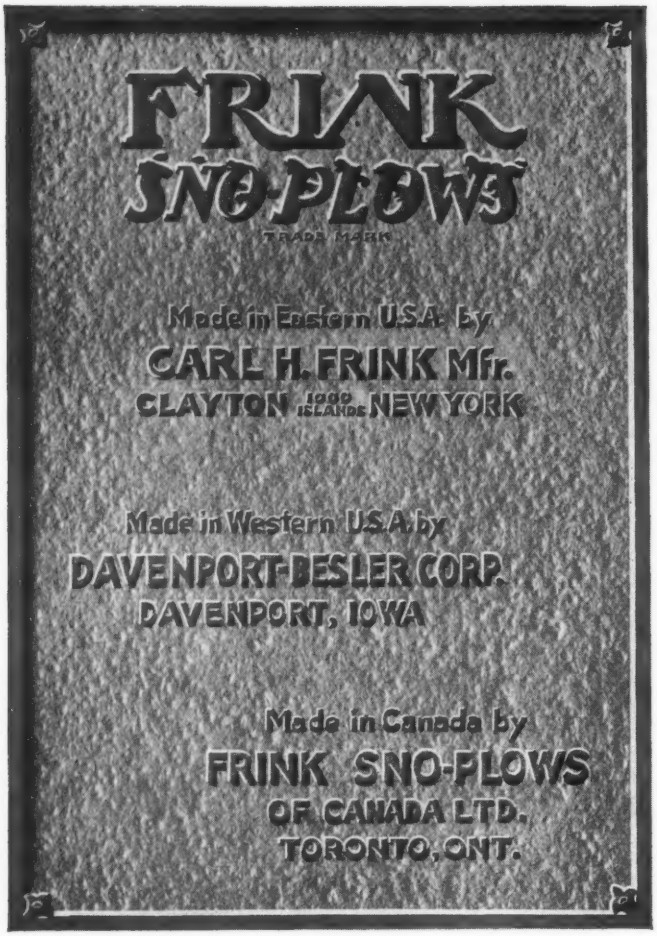

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are offered, so that the work can be expedited by the use of such equipment as it may be expedient to employ, and through the employment by the sponsor of such skilled workers as may not be available from the relief rolls.

WPA projects important for military and naval purposes are prepared and presented in exactly the same manner as other projects. In the cases of projects not sponsored by a Federal Agency, a state or one of its political subdivisions or agencies with competent jurisdiction to perform the work must undertake the responsibility of sponsoring the project. Delay in the processing of applications may be greatly reduced through clearance with the appropriate Federal Agencies concerned prior to the submission of an application to the WPA. These are the regional offices of the Civil Aeronautics Bureau in the case of airports, district offices of the Public Roads Administration in the case of roads, and the United States Public Health Service in the case of health and sanitation projects.

WPA projects concerned with the construction or improvement of airports are considered defense projects when the work has been certified by the War or Navy Departments as important for military or naval purposes. Civil Aeronautics Bureau specifications for the type of airports in question must be met in the case of civil airports. Information as to what airports or locations for airports are vital to the plans of the War and Navy Departments is in the hands of WPA State Administrators and Regional CAB offices, and projects are planned accordingly.

The defense program calls for considerable improvement to the nation's system of roads and highways. New and improved access roads leading to military and naval posts, stations, and concentration areas, and routes within the national strategic system of roads, as determined by the War Department, are of vital importance. For some time the Public Roads Administration has been working in close cooperation with the War and Navy Departments on details of this work.

WPA projects for access roads are developed in consultation with the appropriate Army post or station Commander, or Naval Commandants, the District Engineer of the Public Roads Administration, a representative of the State Highway Department, and with representatives of such local political subdivisions as may have jurisdiction over the roads in question. Projects for access roads, outside of military and naval establishments, must necessarily be sponsored by the State or local governmental agency having competent jurisdiction. It may be possible in some cases for the Public Roads Administration to assist in financing such improvements. The problems of joint participation are worked out in the planning of the project.

The determination of the specific improvements to be made on the national strategic network is made jointly by the Public Roads Administration and the various State Highway Departments. The purpose of these improvements is to bring the system up to the following minimum standards which have been recommended by the Public Roads Administration and approved by the War Department for use wherever practicable:

Surface—Hard surface capable of supporting 9,000-pound wheel load on pneumatic tires.

Width—Minimum of 20 feet. Bridges to be four feet in excess of approach roads.

Bridge Load Capacity—Minimum of H-15 loading.

Grade—Non-mountainous areas, maximum of 5 per cent in lengths greater than 500 feet; mountain

areas, maximum of 8 per cent in lengths greater than 500 feet.

Curvature—Non-mountainous areas, maximum of 6 degrees; mountainous areas, maximum of 14 degrees.

Vertical Clearance—Minimum of 14 feet.

Sight Distance—Non-mountainous areas, minimum of 1,000 feet; mountainous areas, minimum of 650 feet.

In order to expedite to the greatest possible extent the preparation and execution of WPA highway projects important to national defense, both the PRA and the WPA have arranged a maximum decentralization of their activities. Maps prepared jointly by the State Highways Departments and the PRA as a result of the latter's surveys made in cooperation with the War Department are being made available to the individual State Works Projects Administrators. The PRA through its District Engineers assists in the designation of the improvement important to the network of defense highways, and assists in the review of project plans and specifications so that units of work may be undertaken without the delays incident to the submission of final plans and specifications to the Washington office of either the PRA or the WPA.

In view of the necessity for providing employment so far as possible, and due to the limited funds available for non-labor purposes, the most suitable work to be undertaken by the WPA consists of shoulder widening, clearing of rights-of-way, grading, improving road beds, and installation of minor drainage structures, all of which comprise part of the essential work. Other work such as the construction of large bridges, underpasses, pavements, etc., should preferably be undertaken by other agencies, either state or federal, including the Public Roads Administration, since such work is not as adaptable to the WPA program from the standpoint of providing the maximum amount of employment per dollar spent as that mentioned above.

While any individual project requires the preparation of plans and specifications as well as an estimate of cost and the submission of such documents to the WPA State Administrator for approval, in many cases the State Administrators have existing authorization to perform highway work at points within their states without the necessity of submitting the individual projects to the Washington office, and have available at monthly intervals the funds with which to employ certified workers on highway projects. Under these circumstances it may be possible for work of vital importance to commence immediately, provided the sponsor consults with the appropriate State Administrators who are in a position to offer all assistance possible toward expediting operations.

The United States Public Health Service is cooperating with the War Department in determining the immediate health needs of the defense program. In addition to the provision of sanitary facilities within military and naval establishments, this work will cover community, sanitation and malaria and mosquito control in the neighborhood of various military areas. For example, the drainage of swamps to eradicate malaria mosquitoes, and community sanitation work will be of vital importance in maintaining health standards in areas where troops are concentrated as a result of the defense program.

Surveys are now in progress to determine the

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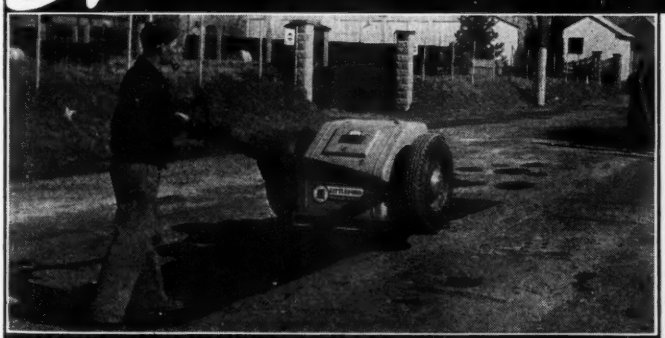

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amount of work mentioned that must be done. Types of work other than community sanitation and malaria control will be given consideration as certified health and sanitation projects only if specifically recommended by the United States Public Health Service.

WPA Builds New Water System in Finger Lakes Region

The output of hundreds of rich mineral springs will be blended with the waters of Cayuga Lake to provide the residents of Seneca Falls, New York, and surrounding communities with a palatable and adequate supply. Upon the completion of this modern and up-to-date water system, 1,250,000 gallons of water will be available daily for a population of 7,000 and for local industry.

This project, one of the largest construction enterprises undertaken by the Work Projects Administration in the N. Y. Finger Lakes area, calls for the building of a new intake, the construction of a filtration and pumping plant and for the laying of a new supply main. The WPA has temporarily suspended work on two other projects in Seneca Falls in order to double the force available for the work on the water system.

For more than a quarter of a century the system from which Seneca Falls has drawn its water supply has been located at Bridgeport, on the north end of the lake. The water from this intake had become objectionable to consumers, particularly during the summer months when the water had an objectionable taste due to the growth of algae. Nor was it uncommon for eels and fish to clog the pumps, while parts of the line had become corroded.

To correct this situation, assistance of the Work Projects Administration was enlisted for a $285,000 project, the village agreeing to furnish $160,000 of the cost.

Canoga Point, with its rich mineral springs, is the nucleus of the new water line, and here on the west side of Cayuga Lake will be located the principal part of the system. In addition to the lake waters, the output of the springs—mineral water which private interests once sold to the residents of the Finger Lakes area—will be brought into the supply line.

The existing distribution system, which runs from Bridgeport to the village and empties into Bayard street, will be utilized. There will be a new 14-inch line which will run from Bridgeport to Canoga Point and then along the new Ithaca Boulevard for a total distance of 29,600 feet.

The filtration plant will be of the rapid sand type. Low lift pumps will raise the water to aerators from which it will flow by gravity through the plant. Within the filter building will be an operating floor, a pump room, a pipe gallery, filter units, a chemical feed and storage room, an ammonia and chlorine room; a laboratory and an office.

A two-car brick garage, and a frame building for the use of the plant operator also will be constructed as part of the project.

The New York State Department of Health, and the Water Power and Control Commission of the State Department of Conservation aided in the preparation of the plans.

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Quartermaster Corps Instructions and Standards for Camps, Cantonments and Air Fields

Information and instructions for constructing quartermasters and engineers in connection with water supply, sewerage and drainage and roadways.

THE Construction Division of the Office of the Quartermaster General, War Department, has prepared information, instructions and standards for exterior utilities for the guidance of constructing quartermasters and engineers. These standards should be of value to all engineers as a guide to practice and procedure in design and construction.

Water Supply

A. Distribution Lines.—(1) Standards: Civil Engineering Standard Specifications covering water lines; standard drawings. Coated and lined steel pipe or transite may be used for long supply lines. If steel pipe is used, the minimum wall thickness shall be not less than 0.25 in. Lining and coating shall be in accord with Tentative Standard specifications 7A.6 of the American Water Works Association. (2) Mains and hydrants are to be located along streets to provide access for fire protection. (3) Hydrants shall be spaced approximately 400 feet apart and so located that each building can be reached by two hydrants based on a hose length of 250 feet.

(4) The looped grid system is desired and no mains shall be less than 6-inch. Dead ends will be eliminated where possible and in no case shall hydrants be located on dead ends. (5) Minimum cover over lines will be dependent on locality and depth of frost. (6) Air and vacuum valves shall be installed on long supply lines only at prominent peaks. Valves shall act automatically, permitting the escape of air from the pipe line while it is being filled, without loss of water, and permitting air to enter the line while it is being emptied. Air valves will not be necessary in the distribution system. (7) Care shall be exercised to prevent any possible cross-connection between the water supply and sanitary sewerage systems.

B. Supply and Treatment Plants.—(1) It should be determined if existing sources are capable of supplying the added demand; if not, the most expedient method of developing the required supply shall be determined. (2) Wells are preferably of the drilled type. Full investigation should be made of the practicability of a well supply and the quality and quantity of water. Local well drillers should be consulted and logs of existing wells studied. Wells should be tested for quality and quantity.

(3) Normally, elevated steel storage tanks are used, but standpipes and surface concrete reservoirs may be used if terrain conditions warrant. If time and delivery are factors, wood stave tanks are acceptable. Tanks and reservoirs should be covered. Risers to steel tanks should be large enough in diameter to prevent freezing. In cold climates omit ladders in risers. Tanks should be so located as to equalize pressures in the area served. Reservoirs should be so located or heights of elevated tanks set as to provide a static pressure of between 50 and 75 pounds per sq. in. through the building area.

(4) Wells are normally pumped with turbine pumps; size and characteristics will depend on size and capacity of wells, standing water level and head above ground. Pumps should not be purchased until this information is known.

(5) Where treatment plants exist, consideration will be given to the enlagement of these facilities. (6) Where new water sources are being developed, information should be obtained as to needed treatment of the water; and it is desirable to submit samples to State Boards of Health or other qualified laboratory for analysis and recommendation.

C. Design Data.—(1) For usual conditions, the average consumption is taken as 100 gallons per day per capita. (2) Pipe line design data: (a) Lines should be designed for a peak flow of 2½ times the daily average or 250 gallons per day per capita. (b) Friction losses, based on Williams and Hazen formula are for c, as follows: cast iron, 100; steel pipe lined and coated, 120; cast iron cement-lined or transite, 130. (c) Where possible, it is desired to have a minimum residual pressure of at least 30 lbs. per sq. in. after line losses have been deducted. A pressure of 15 lbs. is required for proper functioning of flush valves. At Air Corps stations, the flow of water for operating the hydraulic gasoline system depends upon the number and type of fueling pits. Single hose type requires 50 gpm. and double hose type 100 gpm. A minimum pressure of 35 lbs. is required for proper operation.

(d) For fire protection in areas larger than a brigade, or in detached areas, design shall be based on two concurrent fires with a flow of 1,000 gpm. for each fire. In smaller areas, design should provide for one fire at 1,000 gpm. (e) Storage tank capacity, if possible, should provide for a day's supply under restrictions on consumption. For example, if the average consumption were 1 mgd, a storage capacity of 500,000 gallons would be desirable.

Sanitary Sewer Systems

A. Sewer Lines.—(1) Standards: Civil Engineering Standard Specifications covering sanitary sewers; standard drawings. Concrete pipe may be used for sewer lines 20 ins. in diameter and larger; vitrified pipe will be used for lines under 20-inch. (2) Minimum size of lines, including building connections, will be 6-inch. (3) Minimum grades will be such as to produce a velocity of 2 feet per second unless unusual conditions exist. (4) Sanitary sewer system shall generally be separate and not combined with the storm water drainage system. (5) Waste water from Air Corps hydraulic gasoline storage systems shall be discharged into the storm drainage system and never into the sanitary sewer system.

(6) Proper checks should be made with other utilities for clearance between structures. (7) Manholes, in general, shall be located at intersections, at all

breaks in grade and changes in direction, and be spaced not more than 400 feet.

(8) Careful consideration shall be given to the disposition of the sewage effluent, characteristics and flow of stream into which the effluent will be discharged, and the possibility and result of stream pollution. Consideration will be given to the riparian owners and the degree of treatment shall be consistent with local needs and requirements. Local and state health departments should be consulted. Complete treatment may be required to prevent nuisance.

B. Treatment Plants and Equipment. (1) Careful study shall be made of the capacities of existing plants, if any, and consideration given to enlargement or the construction of new units. In most cases new units will be necessary; they may consist of settling and digesting, and aeration units, chlorination and sludge disposal. Degree of treatment will depend upon local conditions and requirements, as stated in the preceding paragraph. (2) In large installations, horizontal pumps in dry wells are desired; for small installations, the vertical submerged type are often practicable. In either case, pumps should be fully automatic and be operated by float switches; and all electrical equipment shall have thermal protection. Pumps shall be provided with adequate concrete sumps and frame shelters.

(3) Chlorinators, where possible, should be of the solution type and a contact period of about 30 minutes should be provided.

C. Design Data.—(1) Sewer line design will be based on a maximum peak flow of 70 gallons per capita per day over an 8-hour period. (2) Treatment plants shall follow State Boards of Health standards. It is the present practice to install standard type army sewage tanks or Imhoff tanks, with trickling filters and secondary settling tanks where required. (3) Pump design will be based on a total daily flow of 70 gallons per capita per day, taken over a 12-hour period. At least two pumps are required for each station; a third pump for standby is desirable. (4) Sumps shall preferably be of concrete and of such capacity that one pump will operate for a period of 10 to 15 minutes after starting, disregarding inflow. For example, a pumping station with two 100-gpm. pumps should have a storage capacity between 1,000 and 1,500 gallons.

Storm Drainage Systems

(1) Standards are based on Civil Engineering Standard Specifications covering storm sewers. (2) Storm drains shall, in general, be separate from sewers. (3) Design of storm drains shall be by a rational method of computing runoff. Rainfall data should be obtained from the Weather Bureau and local authorities consulted. Minimum velocity in pipes shall be 2 ft. per second when possible; minimum size of pipe 6-inch; manholes should be spaced 300 to 600 ft. apart. Storm sewers should be placed low enough to pick up building drains. Minimum cover should be 2 ft. Clearances should be checked against other utilities. There should be no change in grade or direction except at manholes. (4) Waste water from Air Corps hydraulic storage systems shall be discharged into storm sewers, pipes or open ditches. To handle this by gravity, the invert of the drain or ditch should be not less than 7 ft. 0 ins. below ground grade. If gravity discharge is not possible, sumps and pumps must be installed.

Roadways, Runways and Paved Aprons

(1) Civil Engineering Standard Specifications. (2) Roadway plans consist of layout plan, typical cross section, cross section of grading, profiles, structural plan and standard drawing. In laying out street grades consider entire area of Post and attempt to balance within reasonable limits the cuts and fills. This will not preclude borrowing to keep grades reasonable and costs down. Drainage is very important; unless soil below the pavement is kept reasonably dry, pavement failure is liable to occur. Avoid pockets or depressions that will not drain. Road grade maximum 8%; minimum 0.3%, but conditions may cause departure from these grades. The type of surfacing should be the cheapest consistent with traffic and local conditions. Clearing, grubbing and removal of organic material is important. Thorough compaction of embankments is necessary; fill should not be placed when too wet, and water should be added when dry.

(3) Runways: Runway grades are generally flatter than highway or street grades. At points of vertical intersections, the change of grade should not exceed 1% and should be less, if possible. The steps in construction of runways are similar to those in the construction of a highway of a similar type. The surface type, width, location and length of runways will be determined by the Office of the Quartermaster General and the Office of the Chief of Air Corps. (4) Paved aprons have comparatively flat transverse slopes with grades of 0.5% to 1%.

Miscellaneous

(1) Accurate and detailed maps shall be prepared showing the layout of the Post, the exact location of all underground utilities, valves, and other pertinent features. This is necessary not only for a permanent record but for proper operation and maintenance. (2) Standard conventional signs and symbols are to be used in the preparation of all plans. (3). Where utilities are to be designed for tent camps, they shall be so planned and laid out as to be suitable for temporary cantonment construction, if and when a change over is made.

Village of 900 Completes Sewer System and Treatment Plant

The village of Sunbury, Ohio, with a population slightly above 900, has completed with the assistance of the Work Projects Administration a $125,000 sewerage system and disposal plant. Situated at the intersection of three state highways, 20 miles north of Columbus, the residents previously were dependent for sanitation upon primitive methods of waste disposal. The new system, which involved the installation of nearly six miles of sewers, was put in use this spring. With 100 connections at the time of its opening, its potential connections are about 300.

The sewer trunk lines end at the new disposal plant built by WPA workers in a meadow beside Prairie Run, west of the village. The plants consists of a pumphouse, an Imhoff settling tank, two small sludge beds and four sand filter beds.

The plant is designed to handle 100,000 gallons of sewage daily but the only power required for its operation is for an electric pump which raises the sewage into the Imhoff tank, from which point the flow through the plant is by gravity. In the Imhoff tank the settled solids are discharged by gravity through an eight-inch pipe to the sludge beds for drying and disposal.

The effluent from the Imhoff tank flows into a dos-

ing tank, which automatically applies sewage to the sand beds, of which there are four. Siphons are arranged so that the beds are used alternately.

The Sunbury project involved the laying of 30,031 linear feet of pipe, divided into 21,470 feet of eight-inch, 4,500 feet of six-inch, 3,101 feet of 10-inch and 960 feet of 12-inch pipe; and installation of 558 feet of water lines and a fire hydrant. An unique item in the project was the construction of two comfort stations in the Town Hall—unusual in that so small a town should have public comfort stations.

Sunbury now is seeking a new WPA project to increase the height of a dam across Big Walnut Creek, originally built by WPA workers, from which the village obtains its water supply. The growth of the major industry in Sunbury, a creamery which is building a large addition to its plant, and the installation of modern bathrooms since completion of the sewerage system has increased the drain on the community's water supply.

Red Concrete Highway Construction Solves Slow Traffic Problem

The problem of slow vehicular traffic ascending the two-lane highways over the hills of Tennessee has been solved by constructing a third lane of red concrete. The extra lane for slow traffic is placed on the right-hand upgrade side of the highway and is constructed of concrete colored red with iron oxide. A large sign on the pavement at the foot of the grade directs all slow traffic over into the red lane.

This novel construction was carried out as an experiment by the State Highway Department on some two miles of highway on which a grade of about six per cent and a series of horizontal curves limiting the sight distance made it a traffic hazard. Previously, fast traffic would pile up behind trucks ascending the hill. In some instances, serious accidents occurred when impatient drivers attempted to pass the trucks in the face of down-grade traffic.—*Am. Public Works Ass'n.*

Strengthening and Widening Bridges

(Continued from page 10)

peculiar problems. In widening slab, tee beam and arch bridges, the added portion is made of sufficient width to be designed to act independently of the original structure. Detail plans of existing reinforced concrete slab, tee beam and arch bridges are seldom available and it is not possible to check their strength. We, therefore, assume that they possess adequate strength, unless they show signs of distress or are badly disintegrated.

The capacity of most iron and steel girder and truss bridges may be raised to the required minimum by reinforcing the floor beams with cover plates welded on, replacing the stringers with new I-beams and placing a new floor. All new timber floors are of the laminated type built of 2-inch thick sticks resting directly on the stringers and spiked together with 4½-inch cut spikes into a continuous mat extending from end to end of bridge floor, or, in cases where the top of the floor beam is at a higher elevation than the tops of the stringers, from floor beam to floor beam. The timber flooring is secured to the steel stringer with ⅛-inch thick steel plates having a slot which engages the flange of the stringer. All laminated timber floorings are protected with a bituminous macadam wearing surface having a minimum thickness of 1 inch. This

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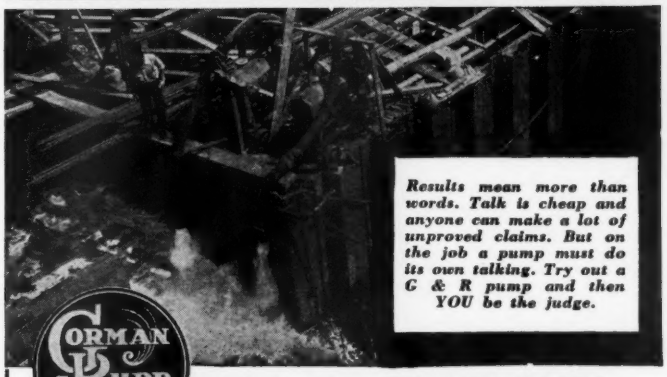
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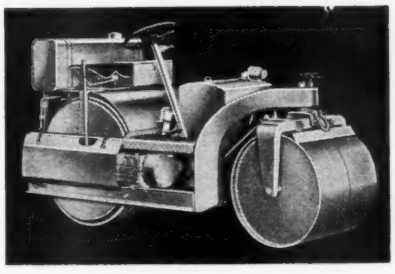

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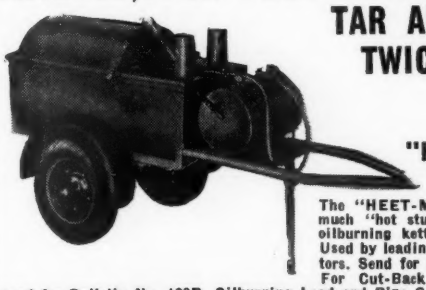

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wearing surface provides a smooth surface and thus reduces impact stresses.

Where it is impossible or impractical to divert traffic while placing a new floor or floor system, vehicles are carried over the operations on a traffic bridge spanning two panels and providing sufficient clearance over the floor so the work may be performed underneath it. This traffic bridge is slid ahead as the work progresses.

When required, truss tension members of pin connected trusses are reinforced with hair-pin loop rods provided with two or three turnbuckles to facilitate placing. Where pins are closely packed, as is usually the case at bottom chord joints, the loop rods are placed on top of the existing eyebar heads, or gusset plates are welded to the pin nuts and the loop rods attached thereto. Standard stub ends are often used in this work. Recently, we repaired several diagonals in a truss in which loop rods could not be used; we cut the eyebars several feet from the pins and welded 1½-inch square bars, upset and provided with turnbuckles, to the edges of the eyebar stubs.

In reinforcing tension members of riveted trusses we simply add a bar or plate or channel on the outside of the member, butt welding it to the gusset plates and tack welding it to the member to prevent rattling.

Compression chord members composed of a cover plate and two channels have been reinforced by welding a plate to the channels and pin plates. This disturbs the chord working line in the least objectionable manner. Chord sections composed of two channels laced top and bottom have been reinforced by removing the top lacing and welding on a cover plate.

Many timber truss bridges have been strengthened by replacing the wood floor beams and stringers with rolled steel I-beams and placing a laminated timber floor.

An inspection of a covered timber bridge this past summer revealed the partial failure of several lower chord splices and the crushing of the wood fibres at several top chord joints. The consequent sagging of the truss pulled the overhead bracing apart and the structure was threatened with collapse on the shearing of the hardwood pins in the bracing. Repairs consisted of bolting steel fish plates to the tension splices and bolting steel brackets cut from 8″ x 8″ x ½″ angles to the overhead bracing. These repairs arrested all further movement.

Concrete-filled steel beam floorings and open mesh steel floorings have been installed on a number of bridges which were strengthened or widened or both. These floorings have the advantage of low dead weight and of spreading superimposed loads over a greater floor area.

A number of bridges have been widened by spreading the trusses or girders. One of these is the Allegheny River bridge at the east end of Warren. This bridge consists of four through truss spans of 138 feet each. This work increased the roadway width from 14 feet to 22 feet. All field connections were electric welded. The attached photographs were taken from approximately the same position and show clearly the transformation of the structure. At the end of the bridge shown in the pictures the roadway is superelevated 11½ inches. Superelevation begins close to the center of the span.

Wood-stave Pipe Laid in Washington

Wood-stave pipe is being laid for new water mains in the State of Washington. The city of Woodland, Wash., has been providing about 1,000 consumers with water through a system about 25 years old, but is now replacing it with a new system as a WPA project. This includes removing 14,000 ft. of old wood-stave pipe and laying 21,235 ft. of 6″ and 8″ wood-stave pipe and 5,165 ft. of 10″; the only cast-iron pipe used being 24 ft. of 10″ pipe under the State highway. The average depth of pipe trench is 4 to 5 ft. There will also be 75 valves and hydrants and 325 service connections; a 140,000 gal. pump and chlorinating plant in a new building, and a new well.

Cost of Garbage Service in Fredericksburg, Va.

With a population of 8,607, Fredericksburg, Va., spent $11,238.04 for garbage service during 1939, according to a report by L. J. Houston, Jr., City Manager. Detail costs are as follows:

Collection	*Total Cost For Year*	*Cost-Per Cap. Per Yr.*
Labor	$5,285.18	$0.6141
Trucks, (oil, gas and maintenance)	398.64	0.0463
Cans	106.11	0.0123
Bags	240.00	0.0279
Truck Depreciation	390.00	0.0453
Total Collection	$6,419.93	$0.7459
Incineration and Can Washing		
Labor—incinerating	$1,796.71	$0.2088
Supplies, fuel and electric current	625.96	0.0727
Repairs—incinerator	572.06	0.0665
Plant depreciation	750.00	0.0871
Can washing	1,073.38	0.1247
Total incinerating and can washing	$4,818.11	$0.5598
Grand total	$11,238.04	$1.3057

The average number of cans in use during the year was 2,245, and the total cost per can per year was $5.01. The average can replacement per year (cans are furnished by the city) is 470, making the average life per can 4.26 years.

The Calendar, the Clock and Sewage Samples

(Continued from page 22)

tests of catch samples of industrial wastes that could be identified have shown the suspended solids running as high as 15,653 ppm, and the BOD as high as 2450 ppm. Considerable laboratory work has been done with catch samples of this nature, and the information obtained is valuable and helpful to the operators in handling these highly concentrated flows when they do enter the plant.

All of the data used in this paper are from the results of the laboratory tests conducted at the Findlay Sewage Treatment Plant, and all figures for the daily and monthly suspended solids and BOD are on record with the Ohio Department of Health. The Findlay plant is of the activated sludge type, with primary sedimentation and separate sludge digestion, and is one of the few plants with garbage grinding equipment. The plant was designed by the H. P. Jones Co., Toledo, Ohio, and was placed in operation during January, 1933.

The writer wishes to express his indebtedness to Ben H. Barton, of the Findlay plant, for his helpfulness in conducting the laboratory tests on the catch samples and industrial waste samples.

Note: This article is based on material presented by Mr. Crohen at the Fourteenth Annual Ohio Conference on Sewage Disposal, but has been revised and rewritten by the author especially for Public Works.

Roma's Novel Water Tower

Shaft for new tank.

ROMA, TEXAS, has recently completed a water works plant the most notable feature of which is the water tower which supports its 60,000-gallon storage tank. Prior to the completion of this system, Roma had no water supply facilities of any kind, the inhabitants using water taken from the Rio Grande river and distributed by cart throughout the community. The Mexican and his water cart shown in the illustration still delivers water for 15c a barrel to a section of the city not yet provided with water mains.

The new supply is taken from the Rio Grande river at a point where it is hoped that the river channel will remain stable for some time, and is purified by a plant consisting of an aerator, chemical feed house, mixing basin, rapid sand filters, clear water well, and pump house containing a pump with a capacity of 250 gpm. The purified water is pumped to the elevated tank above referred to. The tank rests upon a concrete shaft or pedestal, designed by J. W. Baretta, 100 ft. high from its base to the platform upon which the tank rests. It is constructed of reinforced concrete throughout, being a hollow cylinder with a diameter of 11 ft. and wall 10″ thick. It is strengthened by 8 external vertical ribs terminating in parabolic curves at both the base and upper platform slab, which ribs not only strengthen the structure but add greatly to its appearance. A considerable portion of the construction work on the shaft was done from the inside of the tower. The forms for the concrete were held in place by special bolts so arranged that the bolts holding the top of the forms for one pour could be used to hold the bottom of the forms for the next pour.

The project cost in the neighborhood of $111,000, of which $66,000 came from WPA funds and the balance was obtained by a bond issue voted in 1938.

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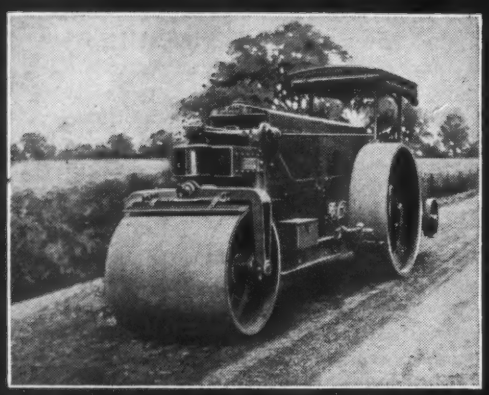

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How National Defense Will Affect Highway Construction

(Continued from page 8)

location of many new arms and munitions factories. The Work Projects Administration was authorized to help finance construction and improvements useful in national defense.

The Federal Highway Act of 1940 provided for the use of Federal road funds to pay engineering costs of the surveys, plans, specifications, estimates, and supervision of construction of urgent improvements on strategically important highways. The Act also authorizes the Commissioner of Public Roads to give priority of approval to Federal-aid road projects officially recommended as important to the national defense.

Still other developments helped to fill in the details of the defense program. Participants in the formal conferences now have before them more exact information on access-road requirements than was available at the preliminary conferences. It is estimated that 2,900 miles of access roads are required for military and naval establishments alone, at a cost of about 194-million dollars.

Examples of Roads Required

Here are some scattered examples of estimates of access-road requirements of individual establishments:

For a naval air station and a nearby Army camp with a total personnel of about 50,000, the road needs were figured at 50 miles of new construction, costing probably 2-million dollars. More than 40 miles of this road were included in the plans for the camp, which has sprung up on the prairie in the last year. The additional 10 miles would be used by both establishments.

Another Army camp for training about 40,000 mechanized troops apparently will require more than 50 miles of road of the first order of importance, at an estimated cost of more than 3¼-million dollars. Another 18 miles is considered desirable for military purposes, and would cost nearly three-quarters of a million. About 35 miles more, at an estimated cost of nearly 1½-million, would be of value at some future time, but is not now of an emergency character.

The road needs of a naval air station with a personnel of 10,000 men and with several auxiliary fields in the vicinity have been estimated to include 30 miles of vital road at a cost of more than 2-million dollars, and about 10 miles of other road which could be temporarily deferred, costing probably more than half a million.

Problems Faced in Planning

In planning access road and street facilities for military reservations, one of the big difficulties of the conferences is in determining the traffic capacity that will be needed. Many camps are expanding from a personnel of a few hundred men to as many as 78,000. Some of them will be used for training mechanized troops.

Investigations by the Public Roads Administration indicate that road requirements of camps that are similar in type and size may differ considerably. The distance to the nearest large city, the distribution of the civil population in the general area, the presence or ab-

sence of direct rail connection with the camp—these are some of the factors, in addition to the size and type of camp, that determine the volume of motor-vehicle traffic in and around a military establishment.

Very preliminary findings hint at a decided difference between the traffic on roads in and around military centers and that on the main highways. Normal traffic shows a gradually increasing volume from Monday through Friday, a considerable increase on Saturday, and a sharp increase on Sunday. The volume of traffic in military areas, on the other hand, apparently continues at a high level from Monday through Friday, with a marked decrease over the week end. This suggests that if access roads and streets are built adequate for the business of a camp, they will have more than ample capacity for all other demands on them.

The Public Roads Administration is making studies to develop a reasonably accurate method of forecasting the volume of traffic that will develop on approaches to different sizes and types of military camps.

The planning conferences have more to do than work out access roads for military camps, however. They must also give some attention to main highways, especially those in the vicinity of camps where the traffic flow will be complicated by the movement of Army convoys in regular maneuvers. On a narrow, two-lane road, a convoy may cause more congestion than perhaps several thousand cars.

While the construction of access roads is definitely the most critical and urgent phase of the program for defense highways, this by no means eliminates action toward conditioning the main highways that have been designated as the strategic system. This conditioning work should continue as rapidly as possible in the regular Federal-aid program.

As revised by the War Department in October 1940, the strategic system now totals 75,000 miles, nearly all of which coincides with the more extensive Federal-aid highway system.

The highway planing surveys that are being conducted by the State highway departments show where improvements are needed to bring this mileage up to modern standards. These are the main weaknesses revealed:

4,000 miles of the strategic system are less than 18 feet in width.

14,000 miles are deficient in surface strength.

2,400 bridges fall below the H-15 standard of strength.

500 additional bridges do not meet the 18-foot standard of width, or the 12½-foot standard of clearance, or are deficient in both respects.

For years, the Army has been designing its equipment for the highways in keeping with peace-time standards of highway construction. The standard H-15 bridges, for example, are strong enough for all classes of military equipment, including tanks up to 50 tons provided they are spaced at least 50 feet apart and slowed down to 4 miles per hour.

All defense-highway improvements undertaken by the Public Roads Administration will be with the assistance of the State highway departments which will carry on the active engineering and supervision work. It will be the policy of the Public Roads Administration to hold steadfastly to the same type of cooperative relationships that have proven effective in the past, and that must be relied on now.

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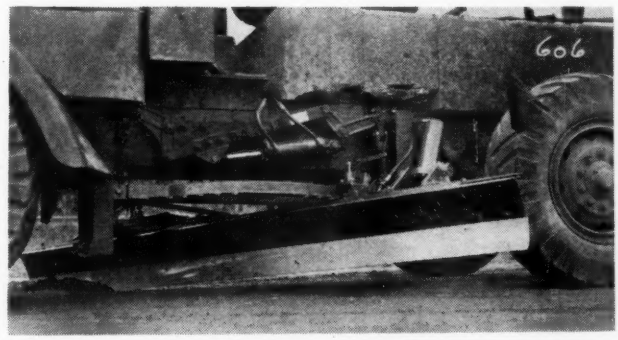

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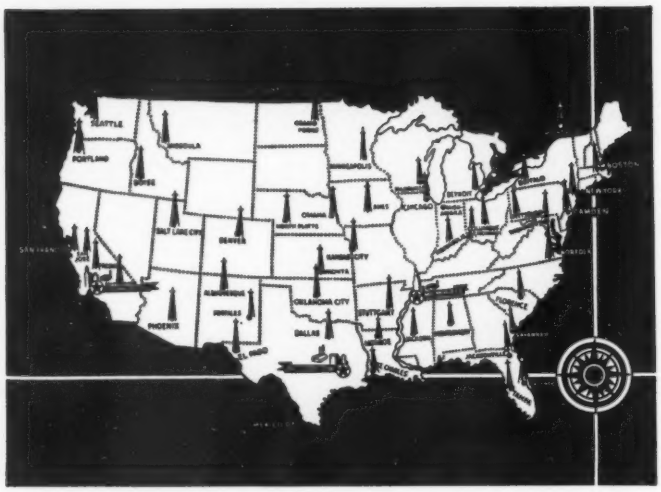

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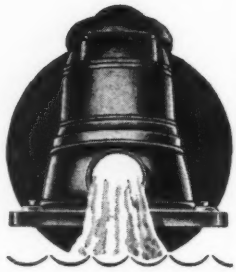

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Water and Sewer Systems at Camp Ord Military Reservation

THE Camp Ord Military Reservation is a training center for coastal military units and is situated on Monterey Bay between the cities of Monterey and Salinas, California. The area contains, roughly, 20,900 acres divided between the artillery range, rifle range and maneuver area.

The War Department entered into a program with the Works Projects Administration to develop a concurrent training camp within the reservation to accommodate 4,000 men and 1,600 animals. This program called for the construction of various small buildings, warehouses, mess halls, etc., together with a complete sewer and water system. Up to this time there had been a very small water system based on the consumption needs of approximately 400 men and 400 animals, and no sewer facilities of any sort, the waste from twenty messhalls being disposed of through small individual cesspools.

The water for the original camp was obtained from a well located at the base of a bluff where an abundant supply was obtained by drilling to a depth of 250 feet, thereby tapping the underground flow of the Salinas river. A 3-phase, 220-volt, 15-hp pump delivered 75 gpm against a surface head of 180 feet, through a 4″ cast iron line to a battery of four 8,000 gallon redwood storage tanks, installed on a twenty-foot tower, supplying water to the camp at a maximum pressure of twenty pounds per square inch.

In the layout of the new water system several factors were involved that were peculiar to this camp. Ten bathhouses were constructed, each one of which had 32 shower heads, 32 lavatories, and 32 toilets equipped with flush valves. Secondly, the maximum elevation for a storage tank available in the near vicinity, was on top of a sand hill 2,500 feet from the camp area. The difference in elevation between this point and the high point of the camp area to be served was 75 feet. Thirdly, to provide for all services required in the area it was assumed that 1,000 gallons per minute would be required during the maximum usage period of 70 minutes per day. This period was considered to take place between 4:30 p.m. and 5:40 p.m., the time when all military personnel had returned from the field and would be washing and bathing.

In order to provide for this increase in usage it became necessary to increase the capacity of the existing well and to provide an auxilary well so that, in case of a mechanical failure, a daily pump supply would be assured. Two new pumps were installed connected to a six-inch water main, one delivering 400 gpm against a surface head of 250 feet and the other delivering 200 gpm against a surface head of 240 feet.

All main water lines are of class 150 cement asbestos pipe, which was used principally because of its low friction coefficient and the ease of installation. The main distribution system within the camp area is of the loop type with connecting laterals, consisting of 5,980 feet of 6″ pipe. The supply is pumped directly into and through this main to an 8″ main, 2,279 feet in length, which directly connects with the storage reservoir. Since the 8″ main serves as a gravity flow line as well as a force line, it was given a larger size in order

to decrease loss through friction. It was found that the 8″ line would provide sufficient water at the branch take-offs and give a minimum of 30 pounds per square inch pressure when delivering 70 gallons per minute per service.

Next, since the maximum usage was to be 1,000 gallons per minute and the maximum pumping supply was slightly under 600 gallons per minute, and since it was considered advisable to confine pumping to daylight working hours, a 200,000-gallon reinforced concrete storage tank was constructed, the entire unit projecting above finish grade. This tank is circular in form, of 42 feet internal diameter, and has a high-water level 21 feet above floor. A heavy foundation was required, as the soil at foundation level was of a sandy loam. The walls were constructed in three sections, using sectional forms to pour the first 7½ feet of the tank, then raising and anchoring the forms and pouring an additional 7½ feet, and raising the forms once more and completing the wall height. As the last operation a concrete roof was poured, supported on 4 square columns. The roof slab was made integral with the columns but is not tied to the exterior wall.

In planning the sewer system, it became necessary to provide for removing waste water at the rate of 1,000 gallons per minute during a peak period. Secondly, since the camp is constructed at a low point of the area, it was necessary to slope the collecting lines to two sumps and pump the raw sewage from these to a treatment plant at an elevation 72 feet higher than the camp area. Here the sewage passes through an open treatment tank of the battery-settled sewage type, the clarified effluent then passing onto a series of filter beds.

All collecting lines were of vitrified clay sewer pipe with cemented joints 4″ to 12″ in diameter. All kitchens and administrative units were carried on one line to a sump in which a 200 gpm vertical sump pump was installed, which raised the raw sewage through a 6″ cement asbestos class 150 pipe to the treatment tank.

Waste water from all bathhouses, of design and size as before mentioned, was carried by one line to a central underground sumphouse in which were installed two 500 gpm horizontal sump pumps. The complete unit, sump, pumps and control switches, were incorporated in a reinforced concrete structure with a reinforced concrete roof, the top of which is at ground level. The raw sewage from this unit is pumped to the treatment tank through a 10″ cement asbestos class 150 pipe.

The open battery treatment tank is a reinforced concrete structure consisting of two filter units, each containing three settling chambers in series, and two siphon chambers, one for each unit. Each siphon chamber will hold 7,700 gallons of settled effluent, automatically discharging into the outfall line connecting the treatment tank with the filter beds. The transfer of raw sewage from one battery of settling tanks to the other battery is accomplished by the manual operation of slide gates within the intake chamber. All settling tanks are bottom connected to a 10″ cast iron sludge line for the periodic removal of sludge from the treatment tank to a sludge drying bed. It is expected that it will become necessary to remove sludge from the settling chambers not oftener than once a year. Ultimately two more filter bed areas of two units each are to be constructed.

In constructing the filter beds, the top soil was removed to reach sand suitable for the purpose, which was found at an average depth of 14 feet. This necessitated the removal of approximately 10,000 cubic yards of overburden for each six-compartment filter

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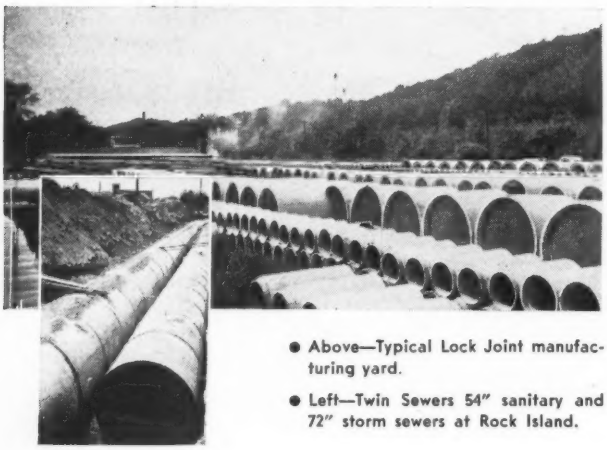

● Above—Typical Lock Joint manufacturing yard.

● Left—Twin Sewers 54" sanitary and 72" storm sewers at Rock Island.

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CONCRETE PIPE

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bed area. The bulk of the excavation was made by a gasoline shovel and trucks, cleanup and sloping of banks being done by hand labor. Due to the type of soil, it was necessary to plant the slopes of each bed to prevent erosion. A rapid-growing, non-irrigated, ice plant, a species of the cacti family common to the peninsula, was used with great success and within six months' time the slopes were heavily matted.

Diversion of effluent from one chamber to any other was managed by a distribution line, running the long axis of the filter bed, in which was installed distributing manholes at central points wherein irrigation gates were installed that might be opened or closed as the proper quantity of effluent had been disposed of in any one filter bed compartment.

Shortly after this sewer and water system had been completed, it was necessary for this system to supply water and sewerage facilities for approximately 12,000 troops. These troops were stationed in this area for a period of four months on an emergency basis. The new system, with the exception of the treatment tanks and filter beds, operated successfully throughout this time with the demand approximately three times the originally designed capacity.

It was, however, necessary to install a new outfall system between the sewage pumps and the Salinas river, and discharge raw sewage directly into the river at a point about two miles from where it empties into the Pacific Ocean. This emergency procedure was entirely satisfactory for operation during this four-month period, as the Salinas river throughout this season is of sufficient capacity to take care of all sewage discharge from this plant. However, in the summer months water in the river is so low that this outfall could not be used. At the present time a project is being operated which will allow for permanent construction of a sewage disposal system to accommodate 12,000 or more troops, if necessary.

The entire work has been done by the Work Projects Administration under the control of William R. Lawson, Administrator for Northern California; and under the direction of Robert W. Mead, District Manager, District 9, Northern California; E. P. Pulliam, Project Director of Monterey County and Richard R. Sturm, Project Superintendent.

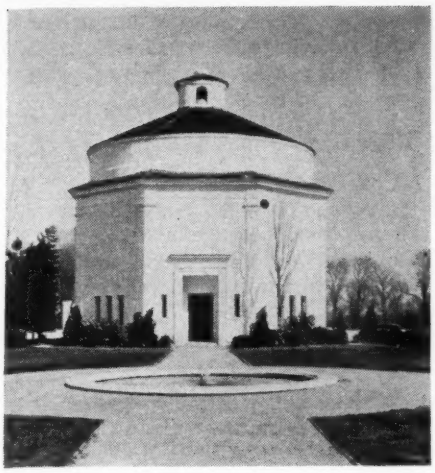
Treating Slippery Pavements

The Rome Division of the Georgia State Highway Department has devised a new treatment of "slippery when wet" pavements for the elimination of skidding hazards on bituminous pavements worn smooth by the constant pounding of heavy traffic. The treatment is temporary in nature, being used only to improve conditions until slippery pavements can be resurfaced.

A strip of "non-skid" surfacing, twenty four inches in width, consisting of a thin layer of asphalt covered with a coat of finely crushed granite or stone chips, is placed on top of, and along the edges of the slippery pavement. These strips provide traction for the outer two wheels of an automobile and reduces the tendency to skid.

Non-skid strips were first placed on a dangerous section of pavement on U. S. Route 41 between the cities of Cartersville and Calhoun. They proved so successful that other slippery pavements are being given the same treatment in various locations throughout the state.

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 55 and 56



Head house of Sacramento, Calif., water supply.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

HOW TO FIND ORIGINAL ARTICLES. Key letter at end of each digest refers to name of publication listed in bibliography at end of this section. Numeral indicates title of article.

New Pipe Cleaning Machine

In cleaning the water mains of the city of Marietta, Ohio, a new type of machine was used particularly applicable to pipes of 4″ and 6″ diameter. This machine used a rotating head driven through flexible rods by a gasoline engine mounted on a small chassis. A section of the pipe having been removed, the revolving head was inserted in the main and rotated, the portable engine meantime advancing slowly and pushing the head forward. The flexible rod was about 48 ft. long and when the head had been pushed the desired distance into the pipe, the machine was disconnected and moved back about 48 ft. and another 48 ft. length of rod attached, until the total length of flexible rod reached or slightly exceeded 1200′. The revolving head consisted of a center shaft with guide collars for centering it in the pipe. Attached to the shaft were short chains, on the ends of which were special hardened cast iron blocks so that the revolving head became a sort of hammer-mill. While the head was moving forward, a small amount of water was permitted to flow through the pipe and when the full section had been cleaned the main was thoroughly flushed. As 1200 ft. could be cleaned in each direction from one opening, in a straight run of pipe it was necessary to cut out openings only every 2400 ft.[A172]

Dry Chemical Feeders

Gravimetric feeders have the following advantages: They are more certainly accurate, the usual guarantees being that they will deliver within 2% plus or minus the rate of feed for which they are set and 1% is obtainable; if feeding stops, an alarm sounds totalizers which keep a record of the total amount fed can be used; they can immediately be set to deliver any desired weight of material per hour without previous calibration; can be equipped with chart type mechanical operation recorders which keep a permanent record of the performance of the feeder.

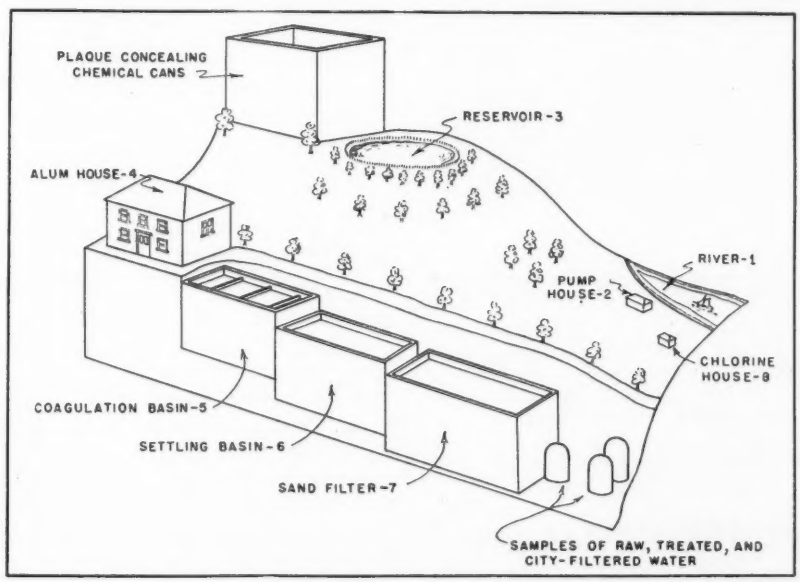
The specifications for dry feeders should call for a hopper capacity of at least 8 hrs. supply at a maximum expected rate; should specify the feeding range that is actually going to be required; should call for mixing chambers in which the material will be retained until thoroughly dissolved (or soaked, if insoluble)—say 3 to 5 minutes at the maximum rate of feed when using sufficient water to give a 10% solution; adequate dust removal equipment; bin gates between chemical feeders and storage bins of over 2000 lbs. capacity; and specify the kind of current available for operating the feeder motors, with possibly the type of motor desired, such as totally enclosed, explosion-proof, 3 phase or single phase, etc.[A179]

Working Model Of a Filter Plant

The educational value of a working model of a filter plant was demonstrated at Philadelphia, Pa. The model was built on a 3 x 5 ft. table. Three aquariums were used for representing the coagulation and settling basins and the filter, the glass sides giving full view of the construction and operating, aided by flash light bulbs and tin reflectors placed behind them, operated by a storage battery. A wooden framework supported, at a higher level, a reservoir, a shallow pan of water representing the source of supply, and cans containing the chemicals. The whole was covered with burlap and plaster of paris and painted. Details and drawings are given.[A1]

Ammonia and Germicidal Efficiency of Chlorine

Experiments to determine the effects of ammonia on the germicidal efficiency of chlorine in neutral solutions, using B. metiens spores, at Iowa State College indicated that the time required to kill 99% of exposed spores increased with increasing amounts of



Courtesy of American Water Works Ass'n

Detail of model of filtration plant

Fig. 1

DO YOU WANT TO "SEE-THRU" YOUR CHLOR-O-FEEDER?

Start the new year right! For $20.00 you can streamline your Chlor-O-Feeder with "See-Thru" reagent end (Fig. 1) and enjoy the many advantages—which are Standard Equipment for the 1941 design—on your old unit. Operation of check valves, diaphragm, piston, etc., bared to constant observation by the operator. Interchangeable parts on all our production line feeders assure our customers that their feeders won't be outmoded and obsolete.

Send purchase order for "See-Thru" parts at $20.00 F.O.B. Providence, with Serial Number of your feeder—we will ship immediately.

You can, if you prefer, return your unit for complete overhaul and modernization with "See-Thru" at slightly higher charge. Write us for quotation.

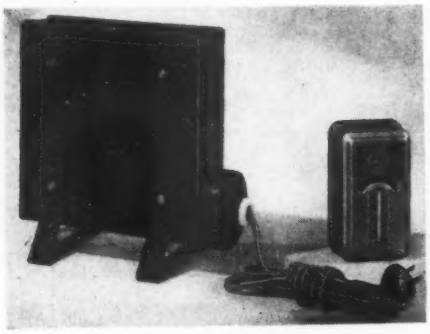


Fig. 2

WINTER IS HERE!

Chlor-O-Heater (Fig. 2) is a standardized unit for use in chlorinator houses, pump houses or in any water works or sewage plant enclosure for apparatus whose operating efficiency might be impaired by zero weather.

700 Watt size, 110 or 220 volt
only $37.50 F.O.B. Providence.

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ammonia but was a direct function of neither available chlorine added nor residual chlorine. Residual chlorine in the presence of ammonia is not a direct function of chlorine added, but rose to a maximum and then dropped to a minimum of practically zero when the ratio of chlorine to ammonia was approximately 7.1, and further additions of chlorine resulted in corresponding increase in chlorine residuals. With water buffered at pH 7.0 containing 10 ppm ammonia, it was found that approximately the same residuals were obtained whether the chlorine added was 95.5, 61.5, or 28.0 ppm, while the respective killing times were 2.7, 88, and 83 minutes. In view of these results it seems probable that, at a point below the minimum residual, the available chlorine exists in the form of chloramines; that at the point of minimum residual probably all of the ammonia has been oxidized; and that beyond this point the residual is due to HOCl, which is particularly affective as a germicide.[A181]

Effect of Temperature On Floc Formation

Study of the cause of decreased effectiveness of flocculation in cold weather in preparing water for rapid filters led to the conclusion that changes in temperature have no measureable effect upon the time of formation of floc if coagulation takes place at the optimum pH value, but this value is shifted by changes in temperature; the influence of temperature being greatest for the smallest coagulant doses. Also the optimum pH value is shifted by changes in the amount of coagulant used, and the greatest economy of coagulant is obtained if flocculation takes place at the optimum pH value. It is therefore quite important for economy of coagulation that jar tests for optimum pH be made at the temperature of the raw water and not at room temperature, for which purpose it seems desirable to equip laboratory stirring devices with constant temperature baths. [A182]

Electric Grounding On Water Services

The use of water services in buildings for the grounding of electrical installations in the same building has become common practice, and yet some water works men are not satisfied that it is a desirable or even safe one. The attitude of the American Water Works Association is summarized as follows: "Water works men wish to cooperate in all well considered activities looking toward the protection of the public.

"They do not recognize the right of any other public service group to make use of the water system as an incident to the rendering of that service, if the act thus contemplated appears to damage the water supply structures or service.

"They hold the opinion that it is incumbent upon the group wishing to make use of the water supply facilities for purposes foreign to the purveying of public water supply, to demonstrate that the acts contemplated or performed do not or will not damage water supply structures, services, employees or customers.

"Finally, they do not admit the existence of a general legal right of other utility services to make use of the water system for purposes foreign to the conduct of essential water supply service."[A184]

Rating Water Supplies for Approval

During 1939 the Tennessee Division of Sanitary Engineering developed a system for rating public water supplies based on both physical equipment and operation, on the basis of which the approval of the Division is given to or withheld from the supplies. Last October only 12 towns had received final approval, which requires a score of 90 points out of a possible 100. In developing the system, several hundred pertinent items were listed, which were finally grouped under the following 16 heads: Source of supply, 10 points; Equipment, buildings and grounds, 5 points; Treatment facilities, 10; Laboratory facilities, 5; Potable water storage facilities, 5; Distribution system piping, 2; Existing cross-connections, absence of, 5; Certified operator, 9; Maintenance of equipment, buildings and grounds, 5; Operation and laboratory control of treatment works, 10; Operation of distribution system, reservoir and tanks, 4; Cross-connection policy, 5; Cooperation with State health department, 5; Physical characteristics, 5; Chemical characteristics, 5; Bacteriological quality, 10. Approval is withheld unless at least 75% of the population is served with the supply.[A2]

Manganese In Reservoirs

Manganese in reservoir water is believed to be due to the digestion of excessive organic material in the reservoir bottom, which produces CO_2, which in turn dissolves manganous oxides from rock deposits. The manganese has an annual cycle which is closely paralleled by the increase in CO_2 and by the reduction in the amount of dissolved oxygen in the water. Manganese peaks coincide with the decline of water temperatures in the fall, signifying a turnover; and do not at all parallel those of iron and turbidity. The amount of manganese in the reservoir varies inversely as the quantity of stream flow. The earlier the manganese begins to increase in its annual cycle the higher the peak will be; it usually occurs in Baltimore about November 1.[A5]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n,* note or short article; *p,* paper before a society (complete or abstract); *t,* technical article.

A *Journal, American Water Works Ass'n. November*

170. Capacity Requirements and Design of Distribution Reservoirs. By R. C. Kennedy. Pp. 1819-1833.
171. Relationship Between Fire and Water Dept's. By J. W. Stevens. Pp. 1834-1842.
172. Rehabilitation of Water Mains. By E. S. Hoyt. Pp. 1843-1847.
173. Ownership and Maintenance of Service Lines and Curb Boxes. By W. C. Shoemaker. Pp. 1848-1852.
174. Increasing Water Sales. By D. W. Robinson. Pp. 1853-1856.
175. Ground Water for Public Supply in Western Pennsylvania. By R. M. Leggette. Pp. 1857-1866.
176. Relation of Waste Disposal to Western Pennsylvania Water Supplies. By C. H. Young. Pp. 1867-1882.
177. *n.* Under-Water Cutting Tool for Aquatic Plants. By B. B. Harris and J. K. G. Silvey. P. 1883.
178. Photo-Electric Control for a Drinking Fountain. By J. E. Kleinhenz. Pp. 1884-1885.
179. Chemical Feeders. By L. E. Harper. Pp. 1886-1895.
180. A Small Pressure Filter Plant. By W. W. Watkins. Pp. 1896-1903.
181. *t.* Effects of Ammonia on the Germicidal Efficiency of Chlorine in Neutral Solutions. By G. R. Weber, R. Bender and M. Levine. Pp. 1904-1912.
182. *t.* Effects of Temperature on Rate of Floc Formation. By T. R. Camp, D. A. Root and B. V. Bhoota. Pp. 1913-1927.
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1. A Working Model of a Filtration System. By H. J. Abrahams. Pp. 1975-1985.
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4. Pollution of Drinking Water Through Cross-Connections with Fire Lines (at Treasure Island). By J. C. Geiger. Pp. 2006-2014.
5. Manganese in the Lock Raven Reservoir. By A. Wolman and R. B. Stegmaier, Jr. Pp. 2015-2037.
6. Distribution System Analysis in Edmonton. By C. K. Hurst. Pp. 2038-2051.
7. Recent Problems and Developments in Michigan. By R. J. Faust. Pp. 2052-2059.
8. Maintaining Water Service in Sub-Zero Weather (in Kentucky). By E. Farra. Pp. 2060-2066.
9. Radio-Directed Water and Sewer Service. By K. F. Hoefle. Pp. 2067-2070.
10. The Use of Copper and Brass Tubes. By C. S. Cole. Pp. 2071-2076.

D *The Surveyor*
December 6

1. *p.* Water Sterilization: Choice of Method. By E. F. W. Mackenzie. Pp. 291-293.

E *Engineering News-Record*
December 5

1. Camp Water Supply and Sewage Disposal. Pp. 73-74.

December 19

2. Treatment for Delaware Water (New York City supply). Pp. 54-58.

F *Water Works Engineering*
December 4

1. Corrosion Control by Water Treatment. By C. R. Cox. Pp. 1514-1516, 1549.
2. Social Security to Cover Public Employees. Pp. 1517-1518.
3. Laying Distribution Mains. Pp. 1522-1523.

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4. Preparing for War and Its Emergencies. By V. J. Wilmoth. Pp. 1570-1574.
5. Corrosion Control by Water Treatment. By C. R. Cox. Pp. 1575-1579, 1596.
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7. Highly Polluted River Water Delivered in Rochester, N. Y. Pp. 1595, 1604.

G *Water Works & Sewerage*
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1. Lime and Lime Slaking. By H. E. Lordley. Pp. 551-554.
2. *p.* Problems in the Management of Municipal Waterworks. By L. R. Howson. Pp. 563-565.
3. Hydraulic Conditions in Continuous-Flow Basins. By R. D. Nichols. Pp. 579-582.
4. *p.* Experiences in Protecting Water Pipes from Frost. By F. J. Reny. Pp. 586-587.
5. *p.* Cost Keeping. By W. M. Porr. Pp. 588-592.

J *American City*
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1. Sabotage of Water Works. Pp. 35-37.
2. Water System of Penns Grove, N. J. Pp. 56-57.
3. Water Rates and Service Charges. Pp. 83, 85, 87.

M *Canadian Engineer*
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1. A New Filtration Plant in the Maritimes (Sussex, N. B.) By M. T. Gray. Pp. 7-10, 46.
2. Cost and Consumption in Canada. Pp. 11-14, 40.
3. Fluorine Content of Alberta Waters. By O. J. Walker. Pp. 16-17, 42.

P *Public Works*
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1. Filter and Pumping Plant for a Modern Institution. By H. K. Bell and G. S. Bell. Pp. 14-15, 44.
2. Amount of Hotel Water and Sewage. P. 18.
3. Water Works Control Equipment. By T. Palmer. Pp. 19-20.
4. Water and Sewage Chemistry and Chemicals. By W. A. Hardenbergh. Pp. 25-30, 32, 34, 36-40.

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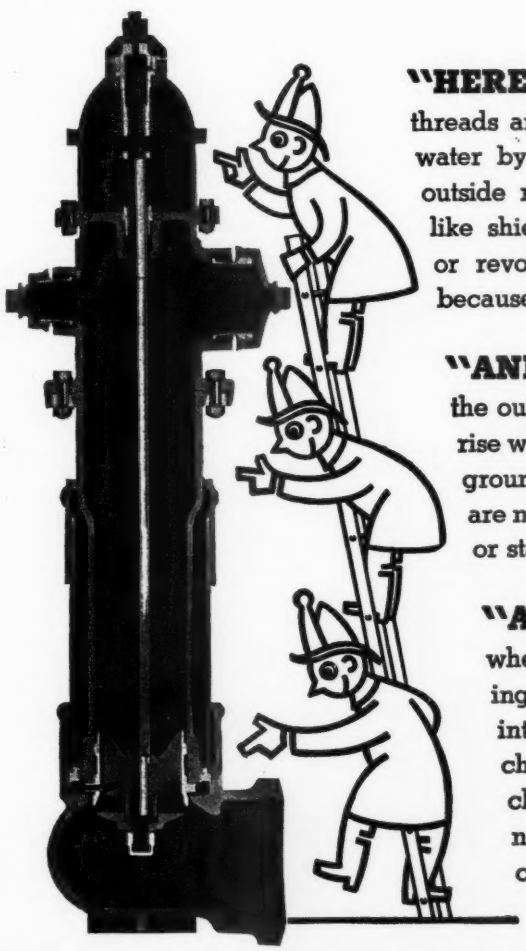
November-December

1. Ground Water—Its Development, Uses and Conservation. Pp. 1-7, 10.

Better Specify MATHEWS BECAUSE IT'S WINTERPROOFED



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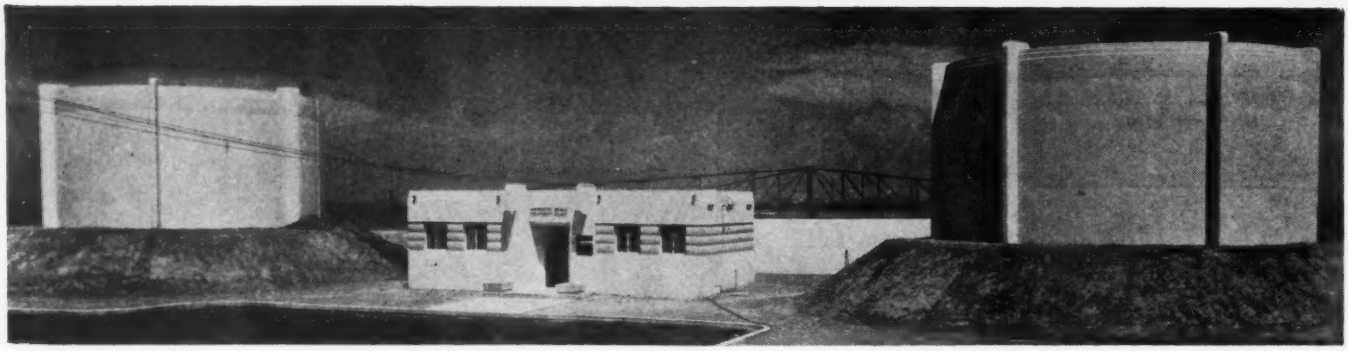


Huntington Beach, Calif., treatment plant; Currie Engrg. Co., consulting engineers

The Sewerage Digest

Precipitation Of Trade Wastes

From experiments on trade wastes at Halifax, England, principally of a soapy and greasy nature, it was concluded that the most economical single precipitant is sulfuric acid at an optimum pH of about 3.2, which is shifted toward the neutral by small additions of alumino ferric. Precipitation by the latter plus acid therefore requires considerably less acid than if the acid were used alone, and the combined cost of the two is less.

The coagulative effect of aluminum sulphate and analogous precipitants is generally ascribed to the formation of positively charged colloidal metallic hydroxides, leading to mutual flocculation of the latter with negatively charged sewage colloids; but in these experiments the pH values were considerably lower than the range at which aluminum hydrate floc formation is completed and it would appear that the aluminum functions principally as the positively charged metallic ion.[D1]

Barging New York's Sludge to Sea

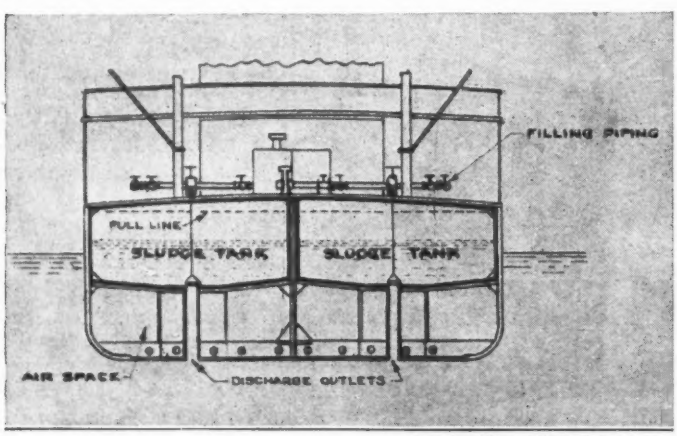
Sludge from New York City treatment plants at Wards Island, Bowery Bay and Tallman's Island is carried to sea, 34 miles south of Wards Island, in three vessels that cost $500,000 each. They

HOW TO FIND ORIGINAL ARTICLES. Key letter at end of each digest refers to name of publication listed in bibliography at end of this section. Numeral indicates title of article.

are twin screw, diesel powered, 257 ft. long, 43 ft. 6 in. broad and 16 ft. deep, with a dead weight capacity of 1430 tons of sludge and speed (loaded) of 10½ knots. The sludge is carried in completely enclosed tanks provided with ventilating stacks containing activated carbon canisters for absorbing odors. Each carries a crew of 18 men including cook and mess boy. The cost of operating and maintaining the vessels in 1939 was $137,931, or an average of 7.5 cts per wet ton or $2.55 per dry ton; of which 71% was for personnel service, 17¼% fuel oil and the balance repairs, supplies and maintenance. It is believed that only three other American communities dump sludge at sea—Elizabeth, N. J., Passaic Valley, N. J. and Providence, R. I. The first of the vessels to go into service made her 1000th trip on Nov. 4, which a group of the city's Public Works officials celebrated by making the trip on her.[G3]

Sludge Removal By Crawler Tractor

Aurora, Ill., in 1940 purchased a crawler tractor carrying steel bins like saddle bags for removing sludge from drying beds. Previously horse-drawn cars on narrow-gauge tracks had been used. The bins, carrying 3 cu.yd., are of 8-gauge metal, readily removable. The engine is rated at 32.4 hp. Carrying a load of sludge it weighs 5 or 6 tons on 1353 sq. in. of crawler surface. The cost was about $2,000 while tracks would have cost $3,000. Labor cost 14.5c. per cu. yd. for removal by tractor, and 48.6c. for removal by horse-drawn cars. The tractor can used as a bulldozer in leveling sludge piles, for clearing snow from driveways, etc.[E1]



Courtesy Water Works & Sewerage

Cross-section through New York City Sludge Vessel

Measuring Flow In Open Channels

A 1″ x 3″ rod is used with one edge double beveled to a knife edge, and graduated to feet and tenths. With the knife edge up stream the depth is measured; with the flat edge up stream the height of the hydraulic jump is measured and from this the velocity calculated. The average error was found to be about 1.64%.[E2]

Sludge Dewatering By Heat Treatment

Humus and activated sludge from the Halifax, England, treatment plant had been found to be "virtually unpressable" by ordinary methods, but the Porteous heat treatment process was used successfully in 1940, dewatering to a cake of 41% average moisture content, which then was readily air-dried to a condition saleable as fertilizer. "The essentials of this process depend on steam heating the sludge to about 300° F. for a short period, whereby the gel structure is so altered and hydration and water affinity of the solids so reduced that the bulk of the aqueous content can subsequently be separated by simple settlement and decantation, and the thickened residue remaining rapidly and easily dewatered by filter pressing, etc. For economical operation, means for conservation of heat are integral with the process."

The Halifax plant was designed to deal with 25,000 gal. of raw sludge, consisting of about 5 parts dry humus to 1 of activated sludge on a dry solids basis, in an 8-hr. day. The sludge is pumped through a heat interchanger into one of four cooking vessels which operate in rotation, each filling for 15 min., cooking 30 min. and emptying 15 min. In each vessel a steam jet draws the sludge into and through circulating pipes, from which it re-enters the body of the tank at the bottom. Gases released are used to

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preheat the boiler feed water and then are burned in the fire. The steam is regulated to maintain a sludge temperature of 360° or over for at least 15 min. Sludge leaving the tank heats incoming sludge in a heat interchanger and then passes into decanters, from which the thickened sludge flows into a storage tank, from which it is pumped to sludge presses. The supernatant from the decanters and the press liquor flow to a settling tank, the supernatant from this going to the percolating filters mixed with settled sewage.

An average of 10 months' operation shows the moisture content reduced from 94.7% in the raw sludge to 89.3 after heat treatment and decantation; to 41.3 in sludge cake, or one eleventh the original volume. The total nitrogen content is reduced from 3.88% to 2.0%. The by-product liquors apparently have no effect on the percolating filters. The overall heat recovery is about 80%, including making good overnight and week end losses.[D1]

Fertility and Fertilizer Values of Sludge

In addition to relatively small amounts of the principal fertilizer ingredients, sewage sludge contains minor chemical elements and growth-promoting substances essential and necessary for proper plant growth. It prevents depletion of humus and is capable of increasing the fertility of the soil. It improves the soil structure in general and increases the water-holding capacity of sandy soil in particular. The value of sludge is not the same for all soils, neither is it the same for all crops. Heat-dried activated or digested sludge appears to be safe for any reasonable use in agriculture, horticulture or floriculture. Claims that it poisons plants and that contained fats clog the soil seem to have little foundation; but the continued use without occasional application of lime may make soil acid. It contains less fertilizer ingredients than do mineral fertilizers and therefore will not give as great crop yield; but it improves the soil, while mineral fertilizers gradually "burn it out." However, its humus content is less than that of barnyard manure.[G1]

Effect of Solvents In Treatment Plants

Most sewages contain volatile solvents and gasoline. Even in considerable quanties these have no practical effect on bacteria generally, although they may be slightly harmful to specific groups. They may cause segregation of fats and increase scum in settling and digestion tanks, from which the grease accumulation may pass to filters and cause clogging, but there is little danger of affecting biological activities. Mineral oil is different; small quantities interfere with biological activities both by toxic action and by coating floc, stone and sand and preventing oxygen reaching them or movement of anaerobic bacteria. Mineral oils decompose at an exceedingly slow rate; they make activated sludge dark in color and less active; in digestion tanks they interfere with digestion, increase scum, and the sludge dries more slowly.[H1]

Corrugated Iron Wall for Trickling Filter

Lakeport, Calif., in its biofilter plant has two 36 ft. circular trickling filters with 3 ft. depth of stone. For filter walls it used two horizontal courses of 18-gauge galvanized "Armco" corrugated sheets, prebent to 18 ft. radius, the upper course overlapping the lower on the inside to prevent dripping. The sheets were riveted together and painted with asphalt inside and aluminum paint outside.[H2]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

D

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November 15

1. *p.* Some Experiments on Precipitation of a Trade Waste Sewage. By C. Lumb and J. P. Barnes. Pp. 239-240.

November 22

2. *p.* Suspended Solids Balance in Puri-

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fication of Sewage by Activated Sludge. By C. Lumb. Pp. 256-257.

December 6

3. *p.* Heat Treatment as an Aid to Sludge Dewatering. By C. Lumb. Pp. 287-291.

E *Engineering News-Record*
December 5

1. Saddlebags on Tractor Expedite Sludge Removal (Aurora, Ill.). P. 49.
2. Measuring Flow in Open Channels. By H. G. Wilm. P. 58.
3. Camp Water Supply and Sewage Disposal. Pp. 73-74.

G *Water Works and Sewerage*
December

1. Fertilizer and Fertility Value of Sewage Sludge. By W. Rudolfs. Pp. 575-578.
2. Hydraulic Conditions in Continuous-Flow Basins. By R. D. Nichols. Pp. 579-582.
3. Sludge Disposal with a Bit of Glamour. By W. Donaldson. Pp. 583-585.

H *Sewage Works Engineering*
December

1. Effect of Volatile Solvents on Bacterial Numbers in Sewage. By H. Heukelekian and H. B. Schulhoff, Pp. 592-594.
2. A Quarantined Lakefront Reclaimed by Biofilter. By H. N. Jenks. Pp. 595-597.
3. Heat Regulation in Digesters at Oshkosh. By R. W. Frazier. P. 598.
4. High-Rate Recirculating Filter for Milk Wastes. By E. F. Eldridge. Pp. 599-600.
5. Glen Cove, N. Y., Refuse Incinerator. By H. W. Taylor. Pp. 605-606.
6. Nylon Brushes for Fine Sewage Screens. P. 611.

J *American City*
December

1. Large Trickling Filter Plant with Sludge Digestion (Des Moines). Pp. 42-44.
2. Using Sludge Gas (Greenwich, Conn.). Pp. 63, 65, 81.

M *Canadian Engineer*
November

1. Typical Sewage Plant (Brampton, Ont.). By D. T. Black. P. 15.
2. *p.* Construction of Sewers. By W. H. Collins. Pp. 18-19.

P *Public Works*
December

1. Landscaping Fargo's Sewage Treatment Plant. By F. W. Pinney. Pp. 11-12.
2. *n.* Sanitation of New Jersey "Public Places." P. 18.
3. Water and Sewage Chemistry and Chemicals. By W. A. Hardenbergh. Pp. 25-30, 32, 34, 36-40.

X *Proceedings, Maryland-Delaware Water & Sewerage Ass'n.*
Year of 1940

1. The Biofiltration System as a Means for Varying the Degree of Sewage Treatment. By A. J. Fischer. Pp. 11-27. By F. S. Friel. Pp. 28-32.
2. Experiments with High-Rate Trickling Filters at Baltimore, Md. By C. E. Keefer and H. Kratz, Jr. Pp. 33-42. By L. H. Enslow. Pp. 42-44.
3. Effect of the Washington Sewage Disposal Plant on the Potomac River. By P. D. McNamee. Pp. 61-70. By R. E. Fuhrman. Pp. 70-73. By R. E. Tarbett. Pp. 73-77.
4. Inexpensive Contrivances Which Have Improved the Operation of a Small Sewage Treatment Works. By C. G. Weber. Pp. 78-89. By H. R. Hancock. Pp. 90-91. By A. L. Genter. Pp. 91-97.

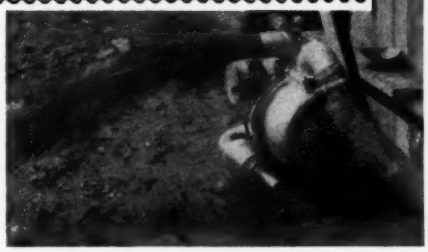
Recovery for Engineering Services

A municipality contracted with an engineering firm for engineering services in connection with the construction of a proposed sewage disposal plant. Through plans, specifications, estimates and data furnished by the engineers the municipality secured a Public Works Administration grant which would have enabled it to erect a plant and passed the necesssary ordinances relative to the doing of the work. These ordinances the municipality voluntarily repealed subsequently, and by its delay caused such a retardment of the recovery program as to cause the grant to be rescinded. The engineers brought action against the municipality on the contract for engineering services and on quantum meruit for sums expended for wages in preparation of a survey report, plans, specifications, etc. The Illinois Appellate Court (Charles De Leuw & Co. v. City of Dixon, 22 N. E. 2d 712) affirmed a judgment for the plaintiff for $3,000.

Assignment of Estimate Check Held Valid

A contractor building a sewerage system for a town assigned a month's "estimate check" to a bank and paid for his labor and materials with money received from the bank. The town acquiesced in this assignment and paid the bank what it had advanced to the contractor. In an action by the surety on the contractor's bond to have the money paid to the bank restored and applied to the contractor's material bills, the Fifth Circuit Court of Appeals held (Town of River Junction v. Maryland Casualty Co., 110 F. 2d 278) that the assignment was a legal and not an equitable assignment, which was not defeated by the contractor's subsequent default and the town's failure to make and pay the month's estimate. The town was held not liable to pay the surety again, especially since the money involved actually went to pay only what the surety would have owed if the assignment had not been made.

You can't call THIS PUMP a Stick-in-the-Mud



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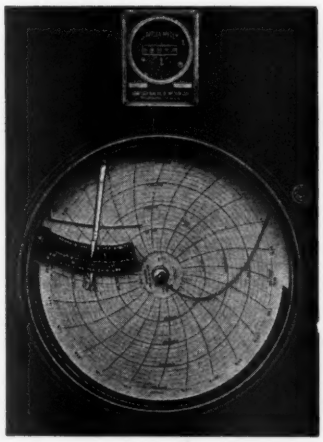

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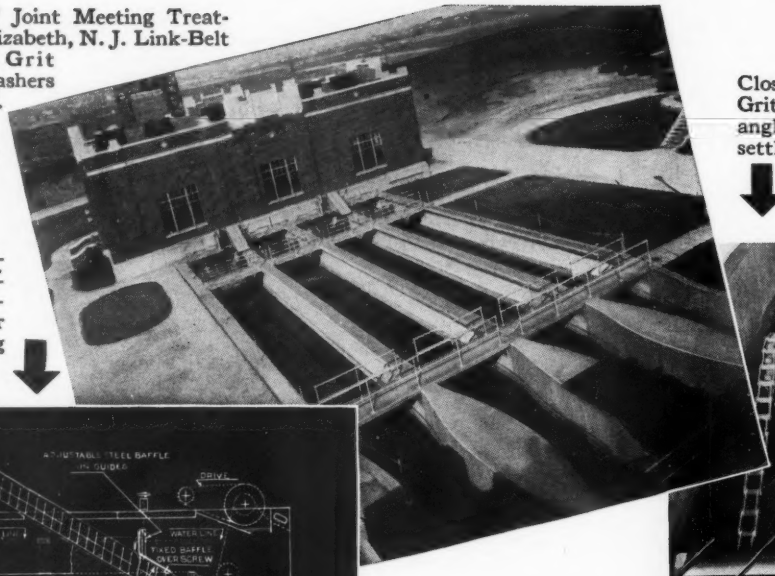
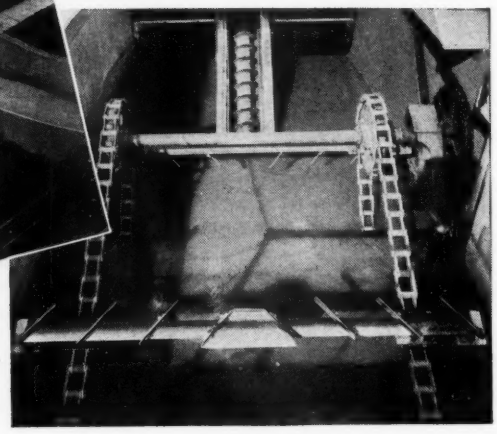
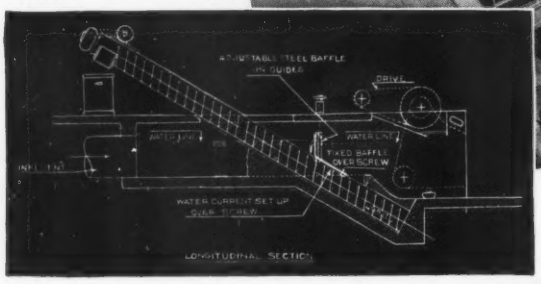
General view of Joint Meeting Treatment Plant at Elizabeth, N. J. Link-Belt STRAIGHTLINE Grit Collectors and Washers in the foreground.



Close-up of Link-Belt STRAIGHTLINE Grit Collector. Note flights set at an angle with direction of travel, which keep settled grit continually turning over, freeing lighter particles of organic matter.



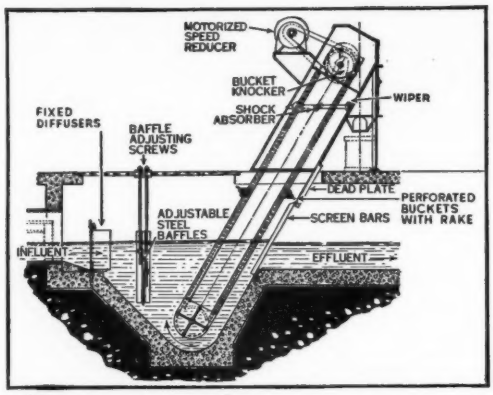
Section of Link-Belt STRAIGHTLINE Grit Collector and Washer showing washing and dewatering screw.



"HERE'S HOW TO "Hit the Grit"

● Remove grit at the earliest possible stage in the treatment of sewage, or it will cause trouble all along the line—in excessive wear of pumps, clogging of valves and siphons, etc. Link-Belt, drawing on extensive experience, recommends the TRITOR, which is a combination of screen and grit chamber, for small and medium size plants, and the STRAIGHTLINE Grit Collector and Washer for larger plants. This latter unit removes grit and similar detritus from the chamber and discharges with a minimum of organic material and moisture.

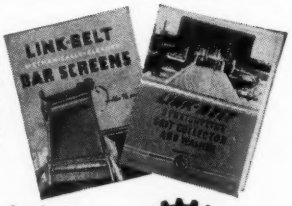
Because it is designed and constructed to keep operating costs at a minimum, with efficiency and flexibility to meet varying conditions, Link-Belt equipment is preferred by many progressive communities everywhere.



Link-Belt TRITOR Screen, which combines the functions of a mechanically-cleaned bar screen and grit chamber.

WRITE FOR THIS *Literature*

Folder No. PW-1942 covering the STRAIGHTLINE Grit Collector and Washer, and Folder No. PW-1587 on the STRAIGHTLINE Bar Screen, and TRITOR Screen and Grit Chamber.



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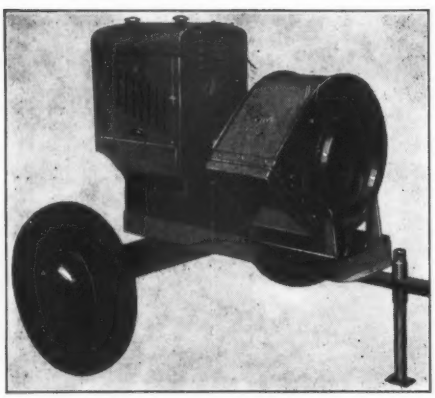
When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 55-57

Keeping Up With New Equipment

Novo Portable Blower

The Novo Engine Company, Lansing, Michigan, announces a new portable blower for the public utility field. It blows out the hot and foul air from conduits carrying heat pipes or other utilities; removes sewer gas where work and inspection has to be done on sewer mains; blows impure air from manholes and any other places where close-quarters must be ventilated to allow men to work safely.

The Novo Blower produces 4,000 cfm of fresh air and is a fast, dependable piece of equipment. The high-speed, spring-mounted, automotive-type trailer allows the outfit to be trailed behind a truck or car at any speed safe for the towing vehicle.



Novo Portable Blower.

The power unit is a heavy-duty, two-cylinder Novo engine. It is very economical to operate and is equipped with a heavy-duty crankshaft on roller and ball bearings, an extra heavy flywheel for smooth operation, and large gasoline, oil and cooling capacities for long periods of operation.

A Rotary Snow Loading Plow

The Bros Sno-Flyer Rotary Loading Plow loads snow from the curb directly into trucks without windrowing. The cutting edges of the plow breaks up hard-frozen windrows so they are quickly and easily handled by the feeding and throwing blades.

The manufacturer claims that loading is accomplished with great speed. With ample snow to load, it is easy to pile high loads on two five-yard trucks per minute with the smallest plow (Size 37). The snow discharged from the loading chute is granular and occupies less than ½ the space required by packed snow. This doubles the hauling capacity of trucks.

When the loading chute is folded down, the entire plow will pass through most garage doors.

Without alteration, this loading plow may be used to cast snow far to either side or to both sides. It is a product of the Wm. Bros Boiler & Manufacturing Co., Minneapolis, Minn. This firm also manufactures rotary, vee-type one-way mouldboard and reversible trip-blade snow plows, in addition to a complete line of road machinery.

Submerged Combustion

A new way to Recarbonate Water

To accomplish the final step in lime-softened water, Ozark Chemical Company, Tulsa, Oklahoma, developed the Submerged Combustion process for recarbonation. An outline of the process follows:

City gas at whatever pressure it happens to be available, and air at atmospheric pressure or compressed air, are piped into a fuel-air proportional mixer which automatically proportions and blends the gas and air to maintain the proper ratio for maximum CO_2 production.

The mixture then passes through a graduated flow control cock, by means of which the volume of fuel reaching the burner is controlled, and on to a motor-driven compressor of the Roots-Connersville type. This compressor is powered by a Standard Electric motor and provided with a starting switch. From the compressor which, together with the flow control cock, determines the pressure at which the fuel is discharged into burner, the fuel passes directly to the submerged burner. This

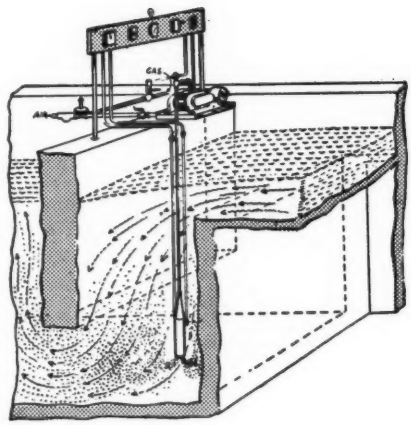


Diagram illustrating submerged combustion.

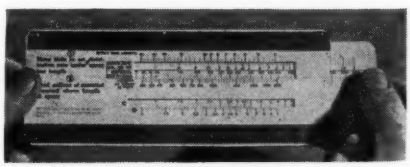
burner consists of a cylindrical section open across its entire section at bottom or discharge end and equipped with a frusto-conical expansion chamber at the upper end, which screws on to the fuel line. Capacity of the installation is determined by the capacity of the compressor and fuel line and diameter of the burner.

An experimental installation was made at the Oklahoma City water works continuing from April 1938 to November by which time a thoroughly successful recarbonating process had been developed, and now the Ozark Chemical Company offers what they claim will be found the logical solution of recarbonation problems. The chief advantages, the manufacturer says, are: lower installation cost, lower operating cost, higher chemical efficiency, lower maintenance due to simplicity of equipment and process, and control ability. Write Ozark Chemical Company, Tulsa, Oklahoma, for complete information.

Bros Sno-Flyer Rotary Loading Plow.

Computing Slide Rule Controls Etnyre Black Top Distributors

With the announcement of a new computing slide rule for operators of Etnyre "Black Topper" Distributors, control of the machines has truly become so simple that "even a school boy can operate them," according to an announcement by executives of E. D. Etnyre & Co., Oregon, Illinois. Not only has operation been simplified, but all guesswork on the part of the operator has been removed, resulting in accurate control of every phase of distribution. This compact slide rule, to be known as the "Etnyre Computator," has tables on *both* sides. By following the instruction sheet and using the specially designed slides, it is possible to quickly determine the Bitumeter or Tachometer settings for spray bar lengths of from 3 ft. to 30 ft., the material required for application up to 3 gals. per square yard, and the solution of any multiplication, division or percentage problem.



Etnyre computator.

Printed on heavy, toughened, cardboard, precision die-cut for accuracy, hot-press laminated with heavy cellophane, the "Computator" is not only durable, but highly resistant to finger smudges. Deposits on the smooth surface can be quickly removed with a damp cloth. And, as added protection, it has been placed in a sturdy "rope" envelope jacket for carrying in a vest, coat or overall pocket. Copies of the "Computator" may be obtained for $1.00 each by writing direct to the company's main office at Oregon, Illinois.

Hawley Method of Sewage Treatment

A sewage treatment plant is offered by the Hawley Engineering Corporation, 3029 Prospect Ave., Cleveland, Ohio, which is a complete transportable unit built wholly of metal. The plant shown in the illustration is 45 ft. long, 10 ft. wide and 5 ft. deep and is claimed to have a capacity to treat 200,000 gallons a day. The operation of the plant as described by the manufacturers is as follows: The sewage first passes through a grit chamber and a rotary drum screen circumferentially slotted with openings .03" or less. The solids form a mat on the periphery of screen which is easily lifted off and passed between the rolls of a wringer, which reduce the water content to as low as 60%. The screenings fall directly into a furnace immediately below, where they are burned. The effluent from the screen enters a so-called separating cone, from which it is drawn by suction through 36 2½" tuyeres which contain tangential blades and which gave the water a rapid rotation whereby it is atomized and oxidized to the saturation limit. The oxidized effluent then flows through three sedimentation tanks with a detention period of one hour; after which the effluent, again oxidized if desired, is discharged into the stream. Solids settling in the settling tanks are returned automatically to the influent ahead of the rotary screen and are removed and burned with the screenings. Any which are not so removed are again aerated and deposited in the settling tanks and returned to screen. Oils and grease are removed by a simple skimming trough and delivered to an oil separator. As the sewage is quickly treated and the odors from furnace are well aerated, the plant, it may be said, is without any odors. It can be manufactured and installed within a period of weeks. The manufacturers of these plants have announced that the total costs of installation will be so small it will be within easy reach of small communities as well as commercial plants, and that operation is exceptionally inexpensive.

New Model International Harvester truck

International Announces Five New Truck Models

Five new light-duty trucks ranging in rated capacities from ½ to 1½ tons are announced by International Harvester Co.: the ½-ton Model K-1, ¾-ton Model K-2, 1-ton Model K-3, 1¼-ton Model K-4, and the 1½-ton Model K-5. Wheelbases range from 113 to 177 inches and gross vehicle weight ratings from 4,400 to 13,500 pounds.

Outstanding among many important mechanical features of the new Internationals is the new "Green Diamond" engine which, in three sizes, powers the five new models, giving more power with greater fuel economy.

New and highly efficient hydraulic brakes are furnished on all of these models. Two-shoe, double-anchor-type brakes provide greatly improved braking ability for trucks of the various sizes. On the larger-capacity units, Models K-4 and K-5, an entirely new, but fully proved, type of rear wheel brake (the new "Hi-Tork" brake) which marks a new milestone in automotive development, is employed.

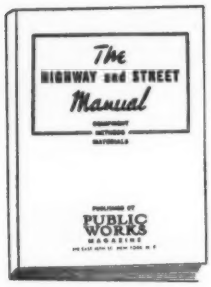
These new Internationals also have full-floating rear axles (except in the ½-ton and ¾-ton models), roller bearing anti-friction universal joints, improved self-aligning propeller shaft center bearings in the long-wheelbase chassis, rubber-cushioned three-point engine mounting, rubber-mounted radiator, sealed beam headlights, mechanical shift starter, oil bath air cleaner, sturdy truck-type clutches and transmissions, and two-speed rear axles in 1¼ and 1½-ton models.

New Koehring Concrete Mixer

Koehring has designed a 14-S mixer (Koehring Dandie) with an end discharge arrangement. This new model is fully illustrated and described in the new Koehring 14-S bulletin K-166, just released for distribution. Complete specifications and dimension drawings are included.

A Hawley treatment plant for 200,000 g.p.d.

Find Data QUICKLY on EQUIPMENT, MATERIALS and METHODS in



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5. **Provides these IMPORTANT FACTS IN ONE PLACE, for quick and easy use, for the whole highway industry.**

If you don't have a copy of the 1940 edition, ask how you may obtain one.

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Blueprint Filing Cabinet

A cabinet for filing master drawings, tracings and blueprints on sheets in practically all sizes up to 48″ x 36″ made of all steel in units with either five drawers or three drawers, each complete in itself, giving great practicability and designed so that they never bind or jam, is made by the All-Steel-Equip Company, Aurora, Illinois. When specified, all cabinets can be equipped with strong locks and each unit is locked separately so that confidential drawings may be kept safe.

Write for folder giving detailed information.

Edward A. Phoenix, Johns-Manville Co., Feted by Business Associates

Edward A. Phoenix, assistant sales promotion manager in charge of industrial products for Johns-Manville Sales Corporation, was honored December 3 by a luncheon at the Hotel Commodore in New York which marked his completion of twenty-five years of service with the organization.

During the luncheon, which was attended by over 100 of his friends and associates, Mr. Phoenix was made a member of the J-M Quarter Century Club, honor society of the company's employees with 25 or more years of service. Lewis H. Brown, president of Johns-Manville, presented Mr. Phoenix with a gold watch emblematic of membership in the Club, while colleagues gave him a gold watch chain, fob and scroll in appreciation of his work.

L. R. Hoff, president of Johns-Manville Sales Corporation, H. M. Shackelford, vice president in charge of sales promotion, and Arthur Elsenblast, staff manager in charge of filter products, also spoke briefly on their association with Mr. Phoenix.

Caterpillar Promotes Officials

Caterpillar Tractor Co. has announced two important advancements in the company's organization.

Donald A. Robison, formerly General Sales Manager, has been made a Vice-President of the company with administrative direction of all selling and advertising activities. Gail E. Spain who joined the Caterpillar organization in 1929, and since 1938 has been Manager of the Sales Development Division, is now General Sales Manager.

Sterling Engine Co. Elects New President

Addison F. Vars, the well-known Buffalo Advertising Agent, has been made President of the Sterling Engine Company, Buffalo, N. Y. Edward H. Townsend was elected Vice President and Treasurer. Spencer H. Logan, formerly president, was elected Chairman of the Board, succeeding Charles A. Criqui, now Vice Chairman.

The Fisher Scientific Co. Acquires Interest in Eimer & Amend

The Fisher Scientific Company, Pittsburgh, Pa., has acquired a substantial interest in Eimer & Amend. Plans contemplate placing the facilities of both organizations at the disposal of the customers of each house. The new directors are Chester G. Fisher, Carl G. Amend, Aiken W. Fisher, Raymond J. Stein, Charles W. Hogg.

Columbia Chemical Division of Pittsburgh Plate Glass Co.

Sale of chemical products manufactured by the Pittsburgh Plate Glass Company will be handled in the future by the Company's Columbia Chemical Division. Previously, such chemicals as soda ash, caustic soda, and chlorine were sold through The Columbia Alkali Corporation, a wholly owned sales division.

This action does not affect the personnel or sales organization. Customers will merely purchase direct from the Columbia Chemical Division of the Company. Eli Winkler, executive sales manager, and W. I. Galliher, director of sales, will retain their respective positions.

The status of existing contracts of The Columbia Alkali Corporation and existing distributor relationships will not be affected by the change.

Koppers Company Takes Over the Wood Preserving Corporation

Stockholders of The Wood Preserving Corporation, a Koppers Company subsidiary, at a special meeting here today voted to liquidate the corporation. Its business will be conducted as an operating and sales division of Koppers Company, Pittsburgh, Pa.

Mr. Shipley and Mr. Munnikhuysen stated that the action was taken in order to simplify the Koppers corporate structure and to further integrate operating and sales activities with other divisions of Koppers Company. No changes will be made in the general management of Wood Preserving plants and operations will be continued as at present.

The Wood Preserving Corporation was organized in 1930 as a subsidiary of Koppers Company, and included the consolidation of Ayer and Lord Tie Company, Century Wood Preserving Corporation, National Lumber and Creosoting Company and subsidiary companies. The corporation is engaged in the prefabrication and pressure treatment of timber, with creosote and other wood preservatives, for structural and bridge timbers, telegraph and telephone poles, highway posts, etc.

Readers' Service Department

These booklets are FREE. Use the coupon below or write the manufacturer direct, mentioning PUBLIC WORKS.

Construction Materials and Equipment

Cold Mix Plants

10. New catalog and prices of Portable Bituminous Mixers in 6 to 14 ft. sizes for resurfacing and maintenance. Issued by The Jaeger Machine Co., 400 Dublin Ave., Columbus, Ohio.

Concrete Mixers

44. Catalog and prices of Concrete Mixers, both Tilting and Non-Tilt types, from 3½S to 56S sizes. The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Concreting in Winter

47. "Build Straight Through the Cold Weather Season" explains briefly how to obtain satisfactory winter concrete in less time. Write Michigan Alkali Co., 60 East 42nd St., New York, N. Y.

Drainage Products

71. Modern Culvert Practice — a 72 page book containing valuable data and tables will be sent promptly to anyone interested in drainage by Gohi Culvert Mfrs., Inc., Newport, Ky.

72. "3 Answers to Limited Headroom," a comparison of three ways of providing safe strength and adequate drainage under limited headroom. For copy ask Armco Drainage Products Assn., Middletown, Ohio.

Generators

75. Homelite portable gasoline engine driven generators, both direct current and alternating current type, in sizes ranging from 500 watts output to 3,000 watts output, are fully described and illustrated in new folder. Homelite Corp., 2400 Riverdale Ave., Port Chester, N. Y.

Mud-Jack Method

107. How the Mud Jack Method for raising concrete curb, gutter, walls and street solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities — a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee, Wis.

Paving Materials, Bituminous

111. An excellent booklet issued by The Barrett Co., 40 Rector St., New York, N. Y., describes and illustrates the uses of each grade of Tarvia and Tarvialithic; 32 good illustrations.

Paving Materials, Brick

116. Standard specifications for vitrified brick pavements and brick parking strips and gutters, as adopted by the American Public Works Association. Also standard specifications for bituminous filled brick pavements adopted by the American Association of State Highway officials. If you contemplate using brick for paving, you should have a set. National Paving Brick Ass'n, Washington, D. C.

Pumps

121. New illustrated catalog and prices of Jaeger Sure Prime Pumps, 2" to 10" sizes, 7000 to 220,000 G.P.H. capacities, also Jetting, Caisson, Road Pumps, recently issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

123. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

124. 16-page illustrated bulletin, SP-37, describes and illustrates complete C. H. & E. line of self-priming centrifugal pumps from ½" to 8", including lightweight models for easy portability. C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

125. Homelite portable self-priming centrifugal pump, gasoline driven, in sizes from 1½" to 4", fully described and illustrated in new folder. Homelite Corp., 2400 Riverdale Ave., Port Chester, N. Y.

Road Building and Maintenance

128. Motor Patrol Graders for road maintenance, road widening and road building, a complete line offering choice of weight, power, final drive and special equipment to exactly fit the job. Action pictures and full details are in catalogs Nos. 253, 254 & 255, issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

129. New bulletins illustrate and describe the latest line of Littleford Utility Spray Tanks, Street Marking Units, Street Flushers and Kettles. Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

Rollers

133. New Tu-Ton roller of simple construction for use in rolling sidewalks along highways, playgrounds and other types of light rolling is fully described in a bulletin issued by C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

137. New bulletins describing in detail the new Huber Road Rollers and Huber Maintainers will be sent promptly on request from The Huber Mfg. Co., Marion, O.

138. "The Buffalo-Springfield line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog issued by the Buffalo-Springfield Roller Co., Springfield, Ohio."

139. "Ironeroller" 3 Axle Roller for extra smooth surfaces on all bituminous work. Booklet contains roller data and operation details. Hercules Co., Marion, Ohio.

Soil Stabilization

150. "High-Service, Low Cost Roads" is one of the newer booklets using an effective combination of picture and text to set forth the principals and advantages of road surface stabilization with calcium chloride. Complete, interesting and well illustrated. 34 pages. Sent by Solvay Sales Corp., 40 Rector St., New York, N. Y.

152. The Columbia Alkali Corporation, will be glad to furnish to anyone interested complete information dealing with Calcium Chloride Stabilized Roads. This literature contains many charts, tables and useful information and can be obtained by writing Columbia Alkali Div., Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, New York City.

153. "Rock Salt for Stabilized Roads" is a handy, illustrated booklet telling how to construct and maintain salt-soil-stabilized roads. Sent on request by International Salt Co., Scranton, Pa.

154. "Soil Stabilization with Tarvia"—An illustrated booklet describing The steps in the stabilization of roadway soil with Tarvia will be mailed on request by The Barrett Company, 40 Rector St., New York, N. Y.

Tire Data

158. Handy pocket-size Goodyear Truck Tire Data Book contains load and inflation tables, dimenson data, factors governing mileage, for all types and sizes of truck, earthmoving and road grader tires. Also tables of weights and measures. Write Truck and Tractor Tire Div., Goodyear Tire & Rubber Co., Akron, O.

Tractors

159. "International Diesel TracTracTors" is a 48-page catalog giving full details of TracTracTors, including action pictures with bulldozers, bullgraders, blade graders, wheel scrapers, elevating graders, etc. Sent promptly by International Harvester Co., 180 North Michigan Ave., Chicago, Ill.

Street and Paving Maintenance

Asphalt Heaters

198. Illustrated Bulletins 15 to 20 describe Mohawk Oil Burning Torches; "Hotstuf" Tar and Asphalt Heaters; Portable Trailer Tool Boxes; Pouring Pots and other equipment for street and highway maintenance, roofing, pipe coating, water proofing, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

199. Aeroil "Heet-Masters" for quick heating and melting of tar, pitch, asphalt, etc., with less fuel are illustrated and explained in new catalog No. 196W issued by Aeroil Burner Co., Inc. Box 599, West New York, N. J.

Dust Control

210. "How to Maintain Roads with Dowflake" is a new 58 page illustrated booklet of information on stabilized road construction. Includes specifications and several pages of reference tables from an engineer's notebook. Issued by Dow Chemical Co., Midland, Mich.

211. A complete booklet on dust control titled. "Dust Control and Road Stabilization," describes the use of Columbia Calcium Chloride for dust control purposes and stabilization of roads. Sent on request by Columbia Alkali Div., Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, New York, N. Y.

212. "Are you Annoyed by Dust?" an illustrated circular telling how to prevent dust with calcium chloride. Sent free by Michigan Alkali Co., 60 East 42 St., New York, N. Y.

Sprayers

280. Cutback sprayers with new "single unit safety control" and full control of all spraying operations from the nozzle are described and illustrated in new bulletin No. 190 W issued by Aeroil Burner Co., Box 599, West New York, N. J.

Snow Fighting

Plows

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Features, specifications and method of attaching. Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

Ice Control

351. "Make Icy Highways Safe for Traffic"—a new bulletin by Michigan Alkali Co., 60 East 42 St., New York, N. Y., tells how to use calcium chloride for modern ice control.

(Continued on next page)

USE THIS COUPON

1-41

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PUBLIC WORKS
310 East 45th St., NEW YORK

Please send me without obligation the following booklets listed in your READERS' SERVICE SECTION .....
(indicate by numbers)

Name .....

Occupation .....

Street .....

City ..... State .....

Readers' Service Department

(Continued from page 55)

352. "Rock Salt's 'Auger Action' makes it most effective for removing ice from roads and streets" is a new illustrated folder just issued by International Salt Co., Scranton, Pa.

Sanitary Engineering

Aero-Filter

356. New illustrated bulletin gives complete information on design of Aero-Filters to provide high-capacity, uniform, raindrop application over the entire filter bed. Write Lakeside Engineering Corp., 222 West Adams St., Chicago, Ill.

Air Release Valves

357. Automatic Air Release Valves for water, sewage and industrial uses are described and illustrated in new catalog issued by Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

Analysis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use" is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Activation and Aeration

376. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Diesel Engines

386. Write Dept. 118, Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago, Ill., for data on how the installation of F-M diesels has lowered taxes and made it possible for many communities to pay for their improvements out of municipal power plant earnings.

Feeders, Chlorine, Amonia and Chemical

387. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. % 96 Codding St., Providence, R. I.

Fire Hydrants

390. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Anniston, Ala.

391. See listing No. 410.

Gates, Valves, Hydrants

394. Gate, flap and check valves; floor stands and fittings. New catalog No. 34 gives detail information with dimensions for all types of new full line. M. & H. Valve & Fittings Co., Anniston, Ala.

395. Complete booklet with much worthwhile water works data describes fully Ludlow hydrants and valves. Sent on request. Ludlow Valve Mfg. Co., Troy, N. Y.

396. See listing No. 410.

Gauges

398. The full line of Simplex gauges for filtration plants are illustrated and described in catalog issued by Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Hypochlorinators

400. New illustrated booklet W&T 357 describes this simple, inexpensive means of protecting small water supplies such as summer camps, hotels, swimming pools, dairies, etc., as well as for feeding chemical solutions in the water works plant. Contains typical installation sketches. Write "Wallace & Tiernan Co., Inc., Newark, N. J.

Manhole Covers and Inlets

404. Street, sewer and water castings in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., Lafayette Boul. & Indiana Ave., South Bend, Ind.

Meters, Venturi

405. MS Meters for use with venturi tubes, flow nozzles, etc., in wall, panel, or floor mounting are covered in detail in catalog sent free by Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

406. New bulletin illustrates Builders Air Relay system of transmission for the Venturi Meter which is particularly useful for liquids containing suspended solids like sewage. Eliminates corroson, clogged pipes, etc. Write Builders Iron Foundry, Codding St., Providence, R. I.

Meters, Water

407. Complimentary bulletin W529 tells all about Pittsburgh IMO water meters, "the meters that wear in where others wear out." Write Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

Pipe, Cast Iron

409. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Burlington, N. J.

410. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., 400 Chestnut St., Philadelphia, Pa.

Pipe, Reinforced Concrete

412. Literature describing the manufacture and installaton of Lock Joint Reinforced Concrete Pressure Pipe for water supply lines and sewer force mains. Lock Joint Pipe Co., Ampere, N. J.

Pipe, Transite

413. Two new illustrated booklets, "Tansite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., 22 East 40th St., New York, N. Y.

Pipe Joints, Sewer

415. How to make a perfect sewer pipe joint—tight, prevents roots entering sewer, keeps lengths perfectly aligned; can be laid with water in trench or pipe. General instructions issued by L. A. Weston, Adams, Mass.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklets. Advertising Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis, Tenn.

Meter Setting and Testing

430. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Sand Expansion Indicator

432. New bulletin gives full details of Simplex Sand Expansion Indicators for water plants. Write Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

Sheeting

436. "Metal Sheeting for Lower Average Job Costs" is a new bulletin about light weight sheeting you can use again and again. Issued by Armco Drainage Products Assn., Middletown, Ohio.

Sludge Drying and Incineration

440. "Disposal of Municipal Refuse." Complete specifications and description including suggested form of proposal; form of guarantees; statements and approval sheet for comparing bids with diagramatic outline of various plant designs. 48 pages. Address: Morse Boulger Destructor Co., 216-P East 45th St., New York, N. Y.

441. Full information about Nichols modern, efficient gabage and refuse incinerators now available in the Basket Grate, Continuous Grate, Revolving Grate and Monohearth types will be sent promptly by Nichols Engineering and Research Corp., 60 Wall Tower, New York, N. Y.

442. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Plainfield National Bank Bldg., Plainfield, N. J.

443. Nichols Herreshoff incinerator for complete disposal of sewage solids and industrial wastes — a new booklet illustrates and explains how this Nichols incinerator works. Pictures recent installations. Write Nichols Engineering and Research Corp., 60 Wall Tower, New York, N. Y.

Swimming Pools

446. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

447. 40-page Manual on swimming pools. Includes swimming and pool layouts, specifications, etc., and details concerning Permutit Swimming Pool Equipment. Write The Permutit Co., Dept. G-4, 330 West 42 St., New York, N. Y.

Taste and Odor Control

450. Technical pub. No. 207 issued by Wallace & Tiernan Co., Inc., Newark, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination, a method of discovering the point at which many causes of taste may be removed by chlorination with little or no increase in residual chlorine. Sent free to any operator requesting it.

Treatment

453. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

455. New booklet (No. 1642 on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures; drawings of installations, sanitary engineering data and design details. Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia.

456. New 16-page illustrated catalog No. 1742 on Straightline Collectors for the efficient, continuous removal of sludge from rectangular tanks at sewarage and water plants. Contains layout drawings, installation pictures, and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia, Pa.

457. New illustrated folder (1942) on Straightline apparatus for the removal and washing of grit and detritus from rectangular grit chambers. Address: Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

458. "Sedimentation with Dorr Clarifiers" is a complete 36-page illustrated catalog with useful design data. Ask The Dorr Company, 570 Lexington Ave., New York, N. Y.

459. A combination mechanical clarifier and mechanical digester, The Dorr Clarigester, is explained and illustrated in a bulletin issued by The Dorr Company, 570 Lexington Ave., New York, N. Y.

460. This new 145 page illustrated chemical products book contains 55 pages of Tables, Factors and valuable Reference Data. Issued by General Chemical Co., 40 Rector St., New York, N. Y.

461. Preflocculation without chemicals with the Dorrco Clariflocculator in a single structure is the subject of a new booklet issued by The Door Company, 570 Lexington Ave., New York, N. Y.

462. Dorrco Monorake for existing rectangular sedimentation tanks, open or closed, is described and illustrated in a new catalog sent on request. The Dorr Co., 570 Lexington Ave., New York, N. Y.

Tunnel Liners

480. "Save Money with Armco *Light Duty* Tunnel Liner" is a bulletin you'll want if you are interested in economical, long lasting tunnels. Write Armco Drainage Products Assn., Middletown, Ohio.

Valves (See Gates, Air Release, etc.)

Water Works Operating Practices

491. "Soft Water for Your Community" tells by means of many interesting pictures and text the advantages of soft water to any community. Ask for a copy from The Permutit Co., Dept. G4, 330 West 42nd St., New York, N. Y.

492. "Alkalies and Chlorine in the treatment of Municipal and Industrial Water" is a new compehensive survey filled with tables, charts, cost comparisons, etc., valuable to all who treat large volumes of water. Write Solvay Sales Corp., 40 Rector Street, New York City.

PERSONAL NEWS

The following new appointment as city manager has been reported:
C. Leland Wood, Watertown, N. Y.

The following new appointments as city engineers have been reported:
A. W. Preston, Monterey Park, Calif.
R. W. Fisher, for Los Gatos, San Jose, Calif.
Elzie Steel, Carrollton, Mo.
Wagner Crawford, Nevada, Mo.
C. C. Hammon, for Carrollton, Canton, Ohio.
C. S. Ades, Granville, Ohio.
Bernard Buehler, Nekoosa, Wis.

The following new appointments as water works superintendents have been reported:
J. Fred McMahon, Norwalk, Conn.
Chas. L. Malone, Monticello, Ga.
Paul Waltrip, Charleston, Ill.
Frank Schulewitz, Melrose, Park, Ill.
Marshall S. Duttow, Oak Park, Ill.
Norman E. Ress, Tell City, Ind.
James Conlan, Scarsdale, N. Y.
Rex. D. Currin, Oxford, N. C.
A. J. Keplinger, Bucyrus, Ohio.
C. C. Barnes, Arlington, Tex.

The following new appointments as county engineers have been reported:
H. S. Bullock, Paulding County, Dallas, Ga.
Marion DeK. Smith, Kent County, Chesterton, Md.
R. H. Eddy, Gage County, Beatrice, Nebr.
Henry Green, Paulding County, Paulding, Ohio.

Dr. Edward Bartow Joins Johns-Manville

Dr. Edward Bartow has been granted a year's leave of absence as emeritus professor of the University of Iowa department of Chemistry and Chemical Engineering to join the research laboratories of Johns-Manville Corporation at Manville, New Jersey, as Chemical Consultant, it is announced by L. R. Hoff, Vice President of Johns-Manville in charge of sales and research.

Dr. Bartow, former president of the American Chemical Society and president in 1921 of the American Water Works Association, will act as research consultant in connection with chemical problems involved in all phases of the company's research activities, Mr. Hoff said.

Arthur T. Clark Joins Pomona Pump Company

Pomona Pump Company, whose plants are in Pomona, Calif., and St. Louis, Mo., established an Eastern executive office at 120 Broadway, New York, some months ago with W. B. Turnbull as General Sales Manager. Arthur T. Clark is Sales Engineer, a position for which his long and varied experience particularly fits him. He began as manager of the Greenwich Water Company, was promoted to the head office of the Community Water Service Co. as its chief engineer, was later manager of Morristown, N. J., Water Department; from there he became sales engineer in the Pipe Coating Division of the Barrett Co. Mr. Clark's long connection in important capacities in the Water Works field and the many friends he has made thoroughly qualify him for the special work he is to do for Pomona Pump Co.

Yeomans Appoints New England Representative

Gustavo Preston Company, 113 Broad Street, Boston, Mass., will hereafter be the New England representative of Yeomans Brothers Company, Chicago, Illinois, manufacturers pumping machinery, rotary air compressors, dry vacuum pumps, pneumatic sewage ejectors and sewage treatment equipment.

This appointment brings together a leading sewage and industrial pump organization and an established sales group originating in 1881 and staffed today to render not only engineering service but practically daily pump service.

Societies

Annual Conference of Concrete Industries

The Annual Conference of Concrete Industries will be held in Chicago, February 10, 11 and 12, at Hotel Sherman.

Sessions of the three-day conference, which will be held concurrently with the Concrete Industries Exposition and the annual conventions of concrete products manufacturers and cast stone producers, will be devoted to an exhaustive study of the newest and most efficient methods of modern concrete construction practice. Leading men from all branches of the concrete industry and prominent research authorities will be included in the list of speakers at these open forum meetings.

Tying in with these conventions, manufacturers of equipment and materials employed in concrete construction and the manufacture of concrete products are planning exhibits of their products.

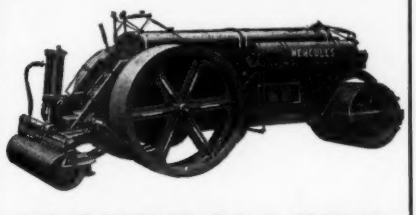
New Jersey Sewage Works Association

The twenty-sixth annual meeting of the New Jersey Sewags Works Association will be held at the Stacy Trent Hotel, Trenton, N. J., on March 20 and 21, 1941.

Arizona Sewage and Waterworks Ass'n

The sixteenth annual meeting of this association will be held in Yuma, Arizona, March 21, 22 and 23. F. C. Roberts, Jr., State Sanitary Engineer, State Board of Health, Phoenix, is the secretary-treasurer.

HERCULES



IRONEROLLERS

The only road rollers with hydraulic Auxiliary Roll and Scarifier interchangeable.

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Write for new catalog.

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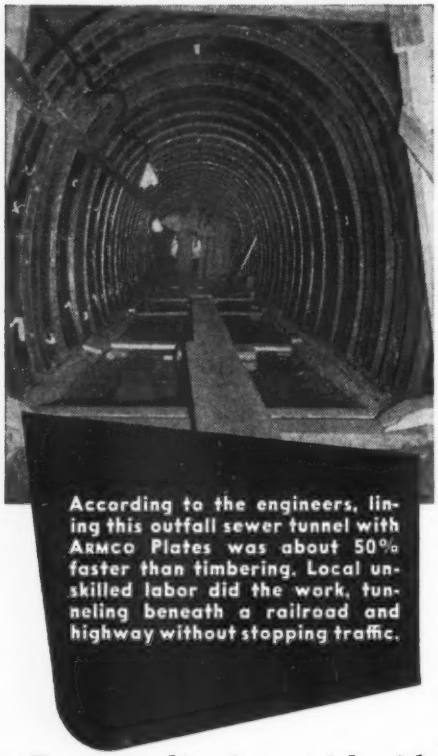
THE HERCULES COMPANY
MARION ~ OHIO

In St. Louis, Hotel Mayfair is the choice of seasoned travelers. They appreciate its downtown location and enjoy its friendly, restful atmosphere, courteous service, comfortable rooms and its restaurants where fine food and drink are traditional.

Every room has private bath, guest-controlled radio. Rates: 50% of all rooms $3.50 or less, single; $5.00 or less, double.

HOTEL Mayfair
Eighth & St. Charles • St. Louis, Mo.
Nearby Parking and Garages

DIG AT TOP SPEED... These Plates Keep Up!



According to the engineers, lining this outfall sewer tunnel with ARMCO Plates was about 50% faster than timbering. Local unskilled labor did the work, tunneling beneath a railroad and highway without stopping traffic.

• Fast tunneling is no trick with ARMCO Liner Plates. Even inexperienced crews can install them quickly and economically. One man easily handles the strong, light weight metal sections, bolting them together with ordinary wrenches. Work moves fast and costs are low.

On a strength-weight basis ARMCO Plates cost less than any four-flanged type. In many cases you actually buy fewer ARMCO plates because their great strength permits the use of alternate rings in partially self-supporting ground. You'll save even more by ordering ARMCO Plates to fit the job. There's a type and gage to meet every condition. Excess weight is out.

Try ARMCO Liner Plates on your next tunnel. Other contractors and engineers find them a big help in "holing through" ahead of schedule and under the estimate. Write for prices and complete facts. ARMCO DRAINAGE PRODUCTS ASSOCIATION, 505 Curtis Street, Middletown, Ohio.

ARMCO

TUNNEL LINER PLATES

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

"How to Choose a Slide Rule"

24 pages—26 illustrations—2 colors. This humorous publication explains for the first time the difference between the various types of slide rules available, in straightforward, salty language. Although written primarily for students in engineering colleges, this booklet contains slide rule information of interest to the entire engineering profession. Free upon request. Keuffel & Esser Co., Hoboken, N. J.

A Special Bulletin for Army Sanitarians

For engineers and contractors who are responsible for water and sewage treatment at Cantonments, Camps, Airports etc., %Proportioneers%, Inc., 9 Codding St., Providence, R. I., has prepared a special Bulletin.

It contains helpful information, whether the plants are permanent or temporary. %Proportioneers% invites you to contact its representatives or to write for a copy of Bulletin DEF.

New Electrifugal Pump Bulletin B-6140

Allis-Chalmers Mfg. Company, Milwaukee, Wisconsin, has issued Bulletin B-6140 on the Company's new all-in-one "Electrifugal" Pumps for 1 to 10 hp inclusive for heads up to 160 feet. It profusely illustrates and describes the unit construction, incorporating either special splash-proof motors, totally enclosed, fan cooled motors, or explosion-proof, fan cooled motors as may be required.

Pictures Tell Money-Making Story for ½ to ¾ Yd. Shovels:

Contractors the world over have found new ways of making money with "little" power shovels—the speedy ½ to ¾ yard machines which have skyrocketed in popularity the past few years.

With 67 photographic illustrations, bulletin No. 2066 just released by Bucyrus-Erie Company tells the on-the-job story of ways in which contractors are making money with these versatile machines. Virtually every phase of excavating, grading and dirt-moving operations is represented; the machines are shown operating as shovels, dragshovels, skimmers, draglines, clamshells and cranes on a wide range of actual jobs.

Copies of the new bulletin No. 2066 are avilable on request from Bucyrus-Erie Company, South Milwaukee, Wisconsin.

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